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# McKay-Rock Creek Watershed Watershed Work Plan

WASHINGTON and MULTNOMAH  
COUNTIES, OREGON

AUGUST 1969

USDA SCS-PORTLAND, OREG. 1969

**LAND  
STABILIZATION**

**RECREATION**

**FLOOD  
PREVENTION**

**IRRIGATION**

**RURAL & MUNICIPAL WATER**

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# ADDENDUM

## McKay-Rock Creek Watershed Work Plan

### CHANGE IN INTEREST RATE

With a 4-7/8 percent interest rate used for the evaluation of this project plan, the average annual benefits of structural measures would be \$2,177,450 and the average annual cost of these measures would be \$702,880. The ratio of benefits to costs would be 3.1 to 1.0.

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August 1969



# *Watershed Work Plan McKay-Rock Creek Watershed*

Washington and Multnomah Counties, Oregon

Prepared under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Washington County Soil and Water Conservation District  
McKay Creek Water Control District  
Washington County  
Multnomah County  
Tualatin Hills Park and Recreation District  
City of Beaverton  
City of North Plains  
Sauvie Island Soil and Water Conservation District  
Wolf Creek Highway Water District

with assistance by:

U. S. Department of Agriculture  
Soil Conservation Service  
Forest Service

August 1969

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# WATERSHED WORK PLAN AGREEMENT

Between the

WASHINGTON COUNTY SOIL AND WATER CONSERVATION DISTRICT

MCKAY CREEK WATER CONTROL DISTRICT

WASHINGTON COUNTY

MULTNOMAH COUNTY

TUALATIN HILLS PARK AND RECREATION DISTRICT

CITY OF BEAVERTON

CITY OF NORTH PLAINS

SAUVIE ISLAND SOIL AND WATER CONSERVATION DISTRICT

WOLF CREEK HIGHWAY WATER DISTRICT

(hereinafter referred to as the Sponsoring Local Organizations)

State of Oregon

and the

SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the McKay-Rock Creek Watershed, State of Oregon, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666) as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the McKay-Rock Creek Watershed, State of Oregon, hereinafter referred to as the watershed work plan, which plan is annexed and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about eight years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. Except as otherwise provided herein, the Sponsoring Local Organizations will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement and provide documentary evidence of these acquisitions (estimated cost \$2,691,500). The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	Sponsoring Local Org. (Percent)	Service (Percent)	Estimated Cost (Dollars)
<b>McKay Creek Multiple Purpose Reservoir</b>			
Payment to landowners for about 407 acres	74.57	25.43	302,000
Cost of relocation or modification of improvements	74.57	25.43	207,100
Legal fees, surveying, and other related costs	100.00	0.00	15,900
<b>Rock Creek Multiple Purpose Reservoir</b>			
Payment to landowners for about 876 acres	58.56	41.44	1,322,850
Cost of relocation or modification of improvements	58.56	41.44	410,750
Legal fees, surveying, and other related costs	100.00	0.00	69,650
<b>McKay Creek Reservoir Recreational Facilities</b>			
Payment to landowners for about 25 acres	50.00	50.00	12,000
Legal fees, surveying, and other related costs	100.00	0.00	500

<u>Works of Improvement</u>	Sponsoring Local Org. (Percent)	Service (Percent)	Estimated Cost (Dollars)
Rock Creek Reservoir Recreational Facilities			
Payment to landowners for about 140 acres	50.00	50.00	307,800
Legal fees, surveying, and other related costs	100.00	0.00	16,200
All Other Structural Measures	100.00	0.00	26,750

The Sponsoring Local Organizations agree that all land acquired or improved with P. L. 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The Sponsoring Local Organizations will acquire, or provide assurance that the landowners or water users have acquired, such water rights pursuant to the State law as may be needed in the installation and operation of works of improvement.
3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

<u>Works of Improvement</u>	Sponsoring Local Org. (Percent)	Service (Percent)	Estimated Cost (Dollars)
McKay Creek Multiple Purpose Reservoir	67.02	32.98	3,080,600
McKay Pumping Plant	73.05	26.95	343,540
McKay Dual Purpose Pipeline	74.10	25.90	791,360
Rock Creek Multiple Purpose Reservoir	39.29	60.71	583,300
Channel Improvement	0.00	100.00	30,970
All Other Structural Measures	50.00	50.00	1,811,400

4. The percentages of the engineering costs to be borne by the Local Sponsoring Organizations and the Service are as follows:

<u>Works of Improvement</u>	Sponsoring Local Org. (Percent)	Service (Percent)	Estimated Cost (Dollars)
McKay Creek Reservoir	40.56	59.44	176,100
McKay Pumping Plant	46.10	53.90	41,300
McKay Dual Purpose Pipeline	48.20	51.80	42,700
McKay Recreation Facility	50.00	50.00	10,200
Rock Creek Recreation Facility	50.00	50.00	33,400
All Other Structures	0.00	100.00	<u>147,650</u>
Total			451,350

Engineering services costs do not include engineering type services related to the acquisition of land and relocation or modification of improvements which are included in item 1.

5. The Sponsoring Local Organization and the Service will each share the cost of project administration which it incurs, estimated to be \$170,340 and \$767,960 respectively.
6. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir that they will carry out conservation plans on their land.
7. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
8. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
9. The Sponsoring Local Organizations will be responsible for the operation and maintenance of all structural works of improvement by actually performing the work or arranging for such work in accordance with the agreements to be entered into prior to issuing invitations to bid for construction work.
10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
11. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
13. No member or delegate of Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
14. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.12), which provide that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

#### WASHINGTON COUNTY SOIL AND WATER CONSERVATION DISTRICT

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the Board of Supervisors of the Washington County Soil and Water Conservation District, adopted at a meeting held on  
\_\_\_\_\_.  
\_\_\_\_\_.

Secretary, Washington County Soil and Water Conservation District

#### MCKAY CREEK WATER CONTROL DISTRICT

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the Board of Directors of the McKay Creek Water Control District, adopted at a meeting held on  
\_\_\_\_\_.  
\_\_\_\_\_.

Secretary, McKay Creek Water Control District

WASHINGTON COUNTY

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of  
the Board of Commissioners of Washington County, adopted at a  
meeting held on

\_\_\_\_\_.

Secretary, Washington County

MULTNOMAH COUNTY

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of  
the Board of Commissioners of Multnomah County, adopted at a  
meeting held on

\_\_\_\_\_.

Secretary, Multnomah County

TUALATIN HILLS PARK AND RECREATION DISTRICT

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of  
the Board of Directors of Tualatin Hills Park and Recreation  
District, adopted at a meeting held on

\_\_\_\_\_.

Secretary, Tualatin Hills Park and Recreation District

SAUVIE ISLAND SOIL AND WATER CONSERVATION DISTRICT

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of  
the Board of Supervisors of the Sauvie Island Soil and Water  
Conservation District, adopted at a meeting held on  
\_\_\_\_\_.

Secretary, Sauvie Island Soil and Water Conservation District

CITY OF BEAVERTON

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of  
the City Council of Beaverton, adopted at a meeting held on  
\_\_\_\_\_.

Secretary, City of Beaverton

CITY OF NORTH PLAINS

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of  
the City Council of North Plains, adopted at a meeting held on  
\_\_\_\_\_.

Secretary, City of North Plains

WOLF CREEK HIGHWAY WATER DISTRICT

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of  
the Board of Directors of the Wolf Creek Highway Water District,  
adopted at a meeting held on \_\_\_\_\_.

Secretary, Wolf Creek Highway Water District

SOIL CONSERVATION SERVICE  
UNITED STATES DEPARTMENT OF AGRICULTURE

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

# *Watershed Work Plan*

## *McKay-Rock Creek Watershed*

Washington and Multnomah Counties, Oregon

August 1969

## **SUMMARY OF PLAN**

### **LOCATION**

The McKay-Rock Creek Watershed is located in the northeast part of the Tualatin River Basin in northwestern Oregon and includes portions of Washington and Multnomah Counties. The Washington County seat, Hillsboro, is located in the southwestern corner, the city of Beaverton is southeast, and the west limits of the city of Portland fall on the east edge of the watershed.

The watershed includes approximately 76,213 acres.

### **SPONSORSHIP**

The application for assistance under Public Law 566 was originally submitted by the Washington County Soil and Water Conservation District and has since been amended twice. The amendments to the application, in addition to adding the Rock Creek area, increased the sponsorship to include Sauvie Island Soil and Water Conservation District, McKay Creek Water Control District, Tualatin Hills Park and Recreation District, the City of North Plains, Multnomah County, Washington County, the City of Beaverton, and Wolf Creek Highway Water District.

This plan was prepared by the sponsors with the assistance of the Soil Conservation Service and the Forest Service of the U.S. Department of Agriculture. The State Engineer of Oregon was designated by the Governor to assist in coordinating activities of State agencies. The State Engineer also assisted on channel and damsite surveys on Rock Creek.

Other agencies who assisted in the preparation of, or furnished material for, the watershed work plan include:

<u>Federal</u>	<u>State of Oregon</u>	<u>Local &amp; Private</u>
Bureau of Land Management	Marine Board	Portland General
Geological Survey	Highway Department	Electric Co.
Weather Bureau	Extension Service	Metropolitan Plan-
Farmers Home Administration	Soil & Water Conser-	nning Commission
Agric. Stabilization and Conservation Service	vation Committee	Columbia Region
Public Health Service	Game Commission	Association of
Army Corps of Engineers	Fish Commission	Governments
Fish and Wildlife Service	Board of Health	
Statistical Reporting Service	Forestry Department	
Bonneville Power Administration	Water Resources Board	
Federal Water Pollution Control Administration	Department Environmental Quality	

## WATERSHED PROBLEMS

The principal problems in this watershed include flooding of cropland and suburban areas along McKay Creek, Rock Creek, and their principal tributaries, inadequate water supplies to meet irrigation and municipal and industrial needs, and limited water-based recreation facilities. Additional problems in the project area include erosion of cropland, erosion on land being developed for urban and suburban uses, and marginal fishery habitat conditions due to prolonged winter flooding and low summer streamflows.

## PROJECT OBJECTIVES

The objectives of this project are to provide flood protection along McKay Creek and Rock Creek, provide adequate full season agricultural water supplies, provide municipal and industrial water supplies to meet needs in the rapidly expanding urban and suburban areas, and to provide water-based recreation facilities.

## PROJECT MEASURES

Project land treatment measures will include practices for watershed protection, flood prevention, land improvement, irrigation water management, and sediment damage reduction. The estimated cost of land treatment measures is \$991,990. The P.L. 566 share is \$91,430 and will consist entirely of accelerated technical assistance to land owners or operators. The share borne by other funds is \$900,560 of which \$12,860 is borne by the Soil Conservation Service, \$7,600 by the

Forest Service, and \$10,000 by the State Forestry Department, programs of technical assistance; and \$832,100 is for the application of measures to be paid for by land owners or operators.

Two multiple purpose reservoirs are the principal structural features of this plan. The reservoir on McKay Creek will have a total capacity of 21,500 acre feet, a full pool surface area of 310 acres, and a dam 143.6 feet high. This reservoir will have capacity for flood prevention, municipal and industrial water, recreation, irrigation, and rural water supply. The Rock Creek Reservoir will have a total capacity of 11,000 acre feet, a full pool surface area of 700 acres, and a dam 47 feet high. The reservoir will include capacity for flood prevention, irrigation, and recreation. Other project measures include a pumping plant on McKay Creek for a combination of irrigation and municipal and industrial water; and two pumping plants for water distribution, one at Rock Creek Reservoir for irrigation and one at McKay Reservoir for rural water and irrigation; a 29,150 foot irrigation and M&I main pipeline, 257,450 feet of irrigation distribution lines, 40,540 feet of channel improvement and recreation facilities on both McKay and Rock Creek Reservoirs. Estimated total installation cost for all structural measures is \$10,723,100.

## BENEFITS AND COSTS

The estimated average annual benefits accruing to structural measures will be \$2,177,450. These benefits include flood prevention, \$39,670; recreation, \$725,000; M&I water supplies, \$612,500; irrigation, \$409,870; and rural water supply, \$710.

The estimated average annual cost of structural measures (including \$501,410 for amortization of installation and \$171,580 for operation and maintenance) is \$672,990.

The ratio of benefits to costs is 3.2 to 1.

## COST SHARING - STRUCTURAL MEASURES

Costs for structural works of improvement are allocated to the purposes served by the structure. The allocation is: flood prevention \$311,500, irrigation \$3,972,460, rural water supply \$5,170, recreation \$3,537,960, and M&I water \$1,957,730.

The total installation costs of \$10,723,100 will be shared with P.L. 566 funds bearing an estimated \$4,698,690 (about 44 percent) and other funds bearing an estimated \$6,024,430 (about 56 percent).

## PROJECT INSTALLATION

The installation of land treatment measures will be the responsibility of the individual landowners or operators with such financial assistance as may be available through the Agricultural Conservation Program or other funds. Technical assistance to landowners will be provided by the Service and the State Forestry Department in cooperation with the Soil and Water Conservation Districts.

Installation of the Reservoirs, pumping plants, pipelines, and channel improvement within the district boundaries will be the responsibility of the McKay Creek Water Control District. Installation of recreational facilities and channel improvement outside the McKay District will be the responsibility of Washington County.

Project measures are scheduled for installation during an eight year period.

## OPERATION, MAINTENANCE, AND REPLACEMENT

Land treatment measures on private land will be operated and maintained by the landowners or operators of the land.

Operation, maintenance, and replacement of the recreation facilities and for channel improvement outside the McKay Water Control District will be the responsibility of Washington County. Operation, maintenance, and replacement of all other structural measures will be the responsibility of McKay Creek Water Control District.

Estimated average annual operation, maintenance, and replacement cost is \$171,580.

## RELATIONSHIP TO BEAVERTON CREEK WATERSHED

A separate work plan is being developed for Beaverton Creek and its tributaries above 185th Street at Aloha. This area is in the application area of the McKay-Rock Creek Watershed for which planning authorization was given, therefore, both plans are being developed under the framework of the one application and one authorization. Project measures of the two plans will not be interdependent, however, when the Tualatin is improved, the reduction in the backwater conditions on lower Rock Creek will allow both projects to share in additional flood prevention benefits for this area.

# DESCRIPTION OF THE WATERSHED

## GENERAL

The McKay-Rock Creek Watershed is located in northwestern Oregon and includes portions of Washington and Multnomah Counties (See Project Map).

The watershed includes approximately 76,213 acres (119.1 square miles) of which 67,599 acres are in Washington County and 8,614 acres are in Multnomah County. About 2,560 acres are Federal lands administered by the Bureau of Land Management and the remaining 73,653 acres are in private ownership or miscellaneous small tracts of public land.

McKay Creek and Rock Creek are located in the northeastern corner of the Tualatin River Basin. The Tualatin is a tributary of the Willamette River which is a tributary of the Columbia River.

There are two incorporated cities within the watershed. Part of the city of Hillsboro (total population 13,000) is located in the southwestern corner and North Plains (population 680) is in the central portion of the watershed. The west limits of the cities of Beaverton and Portland and the intervening metropolitan area fall on the eastern edge of the watershed.

Settlement of the area began in the 1850's as pioneers moved westward from Portland. Agriculture developed quickly in the "Twality Plains" because of the numerous open areas and the suitability of the soils. Some of the earliest donation land claims were established in the area. Joe Meek, "the mountain man," was granted one of these claims.

Hay, grain, and livestock production were the basis of the agriculture economy from the first. Lumbering, railroads, and allied agricultural industries helped to establish the pattern of early development.

In the 1940's the metropolitan area of Portland began to slowly creep into the watershed. With the improvement of access to Portland, the 1950's and 1960's saw a dramatic increase of the metropolitan sprawl into the watershed particularly in the east end where large areas of crop and forest land are being converted to urban and suburban uses. Washington County is initiating a positive policy

## -Description-

of zoning to regulate the establishment of urban areas and to protect the agricultural areas.

## PHYSICAL DATA

### CLIMATE

The watershed has a temperate maritime climate. The winters are wet and mild, and the summers are relatively dry and warm. Convective storms are not common. The average annual precipitation varies between locations in the watershed from less than 40 inches to over 50 inches with an average for the total watershed of approximately 42 inches. About 15 percent of the annual precipitation occurs during the growing season.

The temperatures are generally mild. The temperature varies from -10° to 108°F. The yearly average temperature is 52°F with an average growing season of about 172 days.

## WATER RESOURCES

### Surface Water

The surface water resources of the watershed consist of McKay Creek and Rock Creek including its principal tributary, Beaverton Creek. McKay Creek is a tributary of Dairy Creek. Dairy and Rock Creeks are separate tributaries of the Tualatin River.

McKay Creek originates in the Tualatin Mountains and flows southerly 25 miles to Dairy Creek. Dairy Creek flows southerly 2.9 miles to the Tualatin River.

Rock Creek originates in the Tualatin Mountains and flows southeasterly about seven miles and then flows southwesterly ten miles to the Tualatin River.

The streams have a regular runoff pattern with low flows in the late summer and high flows in the winter months of December, January, and February.

Analysis of water samples taken from watershed streams shows that the water quality is satisfactory for irrigation and recreation. However, municipal and industrial water must be treated prior to final distribution.

### Ground Water

The watershed is located along the northeast flank of the Tualatin Valley syncline, a large structural downfold which has been filled with alluvial clay, silt, and fine sand to depths in excess of 1,000 feet. The flanks and floor of this basin are formed by sequential flows of basaltic lava which are in turn underlain by marine shales and sandstones. These marine rocks are relatively impermeable and thus form an effective seal for ground water collection in the saucer shaped basalt and alluvial valley sections. In addition to the basin supply, there are occurrences of perched water tables in the basalt flows exposed around the valley perimeter.

Most of the present domestic wells, of which there are several hundred within the watershed, obtain their supplies from the valley alluvial fill. Yields range from a few to over 100 gallons per minute. The water table level ranges from near the surface during the late winter and early spring to 20 to 30 feet below the surface during the summer and fall periods. Due to the discontinuous nature of the alluvial fill, the wells vary considerably in depth and yield over very short distances. No high yield irrigation wells (400 gpm or more) have been obtained to date from this formation.

A limited number of wells have penetrated the alluvium and tapped the underlying basalt flows with resulting high yields and in some cases artesian flows. These wells are generally located along the perimeter of the valley near the basalt-alluvium contact. There has also been some production of lesser volumes obtained from the basalt flows above the elevation of the valley plain in the upper watershed. Yields from these basalt wells range from 50 to 600 gpm. The pumping level ranges from 25 to 100 feet.

Production from the marine sediments and from the limited areas of Troutdale sediments and younger Boring lavas is minor and mostly oriented toward domestic supplies.

Present ground water supplies have been developed for use by spring works and numerous small yield shallow wells. Improvements are now being made in the design of deeper wells using larger diameter bores and the use of sand or gravel envelopes in wells which penetrate the alluvial silts and sands. Graphs of observed water levels in the watershed show that the ground water basin is recharged annually by precipitation and runoff. No occurrences of cumulative depletion are evident at present and the indication is that there is a considerable amount of additional ground water available for future development.

### Water Quality

Analysis of water samples taken in the area show that the water quality is satisfactory for recreation, irrigation and domestic use. Water from the various streams has been used for irrigation

for the last 25 years and has not caused any accumulation of minerals or other problems. Domestic water must be treated.

## G E O L O G Y

### Geomorphology

The watershed is located in the northeast quarter of the Tualatin Valley structural basin. The downfolded basalt flows and marine sediments rise up from beneath the valley alluvium into a broad fold forming the steep, dissected topography of the Tualatin Mountains in the upper watershed drainage. The lower watershed consists of a broad alluvial plain sloping gently to the Tualatin River along the southwest watershed boundary. Intermediate between these extremes lies an area of gently rolling footslope alluvial deposits with occasional bedrock outliers. Two prominent bedrock rises break the alluvial plain to the south and form the watershed drainage divide in that area.

Most of the watershed streams originate in the mountainous north and northeast area and pass through this and the upper footslope area in steep, well-defined canyons. These drainage ways broaden through the lower footslope area and upper alluvial plain section prior to their reincision through the lower alluvial plain section to the Tualatin River. Significant gradient breaks occur in conjunction with the geomorphic transitions.

Watershed relief is 1,756 feet ranging from 115 feet above mean sea level (msl) at the confluence of the Tualatin River and Rock Creek to 1,871 feet above mean sea level at the headwaters of McKay Creek. Average elevations for the three geomorphic areas include 200 feet msl on the alluvial plain, 500 msl along the footslope area, and 1,000 msl in the mountainous uplands.

### Stratigraphy

The geologic formations of the watershed are grouped into three units based upon stratigraphic occurrence and amount of areal exposure. Distinctions within the groups identify the total geologic section within the watershed.

Alluvial Deposits: The alluvial plain section and much of the lower footslope area is underlain by alluvial clays, silts, and sands which have filled the Tualatin Basin. Thickness of these materials ranges from a few feet to over 1,000 feet. These materials are generally referred to as "older alluvium." Occasional coarse sands and gravel lenses indicate the presence of buried channel ways. Most of the present stream drainage ways are underlain by younger alluvial deposits of silts, sands, and gravels. These deposits

increase in particle size toward the mountainous areas with considerable cobble and boulder fractions along the footslope-mountainous transition zone.

Tualatin Mountain Flank Deposits: The Boring lavas and Troutdale sediments are **regionally** widespread units, but only locally represented within the watershed. These units are exposed along the southwestern flank of the Tualatin Mountains with the Boring formation overlying the Troutdale.

Tualatin Valley Basement Rocks: The Tualatin Valley and the Tualatin Mountains are underlain by sequential flows of basaltic lava of the Columbia River formation. These flows are massive to highly jointed fine grained basalts which, in the mountainous region, are weathered to depths of 100 to 200 feet. They form the cap rock along the Tualatin divide and plunge beneath the valley alluvium in the central footslope area. Underlying these flows are the tuffaceous marine shales, siltstones, and sandstones of the Scappoose formation. This unit is only exposed along McKay Creek where stream action has incised the basalt cap thus exposing the underlying sediments.

### Structure

The regional geologic structure of the watershed is that of a large synclinal (downward) fold of the basalt and marine sediments with subsequent alluvial deposition filling the basin. The Tualatin Mountains are correspondingly an upward fold forming the northeast and east drainage divide. Superposed upon these broad structures are numerous secondary folds with accompanying fault displacements. The lava flows and sedimentary beds dip off the Tualatin Mountains at from 5 to 10 degrees and pass beneath the valley alluvium reaching a maximum depth of some 1,400 feet beneath the city of Hillsboro.

### CO V E R   C O N D I T I O N S

The upper watershed is forest land consisting of second growth Douglas fir with some western hemlock and western red cedar interspersed with large areas of hardwoods, including areas of red alder, big-leaf maple, and brush species. The entire area has been harvested, but conditions have been conducive for maintaining an adequate vegetative cover. In general, cover condition on forest land is good. In areas of heavy grazing, the forest land cover condition is fair.

The cropland is in a diversified pattern of grains, hay and pasture, and clover seed, with berries, orchards, and other specialty crops. There are scattered patches of forest land and woodlots throughout the cropland. The cover condition is fair for the cropland.

Residential, commercial, industrial, and miscellaneous areas are in good condition except during the initial construction period. The density of these heavily developed areas decreases in a north-western direction across the watershed.

## S O I L S

The soils of the watershed have developed under the influence of relatively high rainfall, mild winters, and moderately hot and dry summers. They are humid soils with the well drained types characteristically light in color while the poorly drained are grey to black. The upper watershed soils of the mountainous and foothill areas are residual types formed from underlying basalt and marine sediments. The lower watershed or Tualatin Plain soils have developed from the older valley alluvial deposits. Flood plain soils along the present stream channels of both the lower and upper watershed have developed from recent alluvial deposits. The following groups are based upon similarities of physical characteristics and agronomic adaptation:

### Group 1 - Upland Soils

Soils in this group are moderately well drained upland soils over 60 inches deep. They are of medium acidity. Slopes range from 0 to 20 percent with inclusions up to 50 percent. Internal drainage and permeability are moderately slow. These soils are productive and can produce high yields of most crops adapted to the area. The predominant soil is Kinton.

### Group 2 - Foothill Soils

This group is rolling uplands intercepted by steep drainage ways. They are 20 to 36 inches deep and imperfectly drained. They are of medium acidity and root penetration of most crops is limited to 36 inches. Slopes range from 0 to 20 percent with inclusions up to 50 percent. Permeability and internal drainage are moderately slow to slow. These soils are best adapted to forage crops, small grains, and fruit trees. The predominant soil is Cascade.

### Group 3 - Footslope Soils

This group is made up of moderately well drained, terrace soils adjacent to rolling uplands. They are 60 inches or more deep and slopes range from 0 to 20 percent. Permeability is moderately slow and internal drainage is medium. Most crops common to the area can be grown on these soils. They respond to artificial drainage. The predominant soil is Helvetia.

### Group 4 - Terrace Soils

These soils are found on terraces and on the valley floor above the floodplain. They are 60 inches or more deep, moderately well

to well drained, and slightly acid. Internal drainage is moderate and water holding capacity is medium to high. Slopes range from 0 to 20 percent. These soils are very productive and can produce high yields of all crops adapted to the area. The soils included are Woodburn, Willamette, and Quatama. The representative series is Woodburn.

#### Group 5 - Valley Soils

These valley floor soils are over 60 inches deep, somewhat poorly drained, and slightly acid. Permeability is moderately slow to slow. Internal drainage is medium and available water holding capacity is medium to high. Slopes range from 0 to 5 percent. These soils are very productive and with some drainage can grow all crops adapted to the area. The soils included are Aloha and Amity. The representative series is Aloha.

#### Group 6 - Poorly Drained Soils

This group consists of floodplain and flat terrace soils, poorly drained, 20 to 36 inches deep. Infiltration, permeability, and internal drainage are very slow. Slopes range from 0 to 3 percent. Crop adaptation is limited to adapted forage crops. The soils included are Dayton and Verboort. The representative series is Dayton.

### RECREATION RESOURCES

The potential resources which can be developed for recreation within the watershed are numerous and adaptable to the varied recreation interests which exist within the study area. Excellent recreation sites are available which provide a variety of topographic and natural beauty environments. Locations range from those of a secluded, nature-oriented, primitive mountain setting to rolling, open, rural countryside areas well adapted to intensive day use facilities. Access from the dense recreation population areas of the north, northwest, and west Portland metropolitan community is direct and is adequate to handle large volumes of user traffic.

The potential recreation community within and immediately adjacent to the watershed is in excess of 200,000 people. There are presently no reservoir-based recreation facilities available in close proximity to this watershed.

### FISH AND WILDLIFE RESOURCES

The McKay Creek Drainage is inhabited by many species of wildlife, including black-tailed deer, upland game birds, small game, furbearers, and limited numbers of waterfowl. Fish species native to the stream system include coho salmon and cutthroat trout. The

wildlife and sports fishery resources are managed by the Oregon State Game Commission. The Fish Commission shares anadromous fish management responsibilities.

Black-tailed deer hunting within the area is fair. Upland game birds include band-tailed pigeons, ringneck pheasant, California quail, blue grouse, ruffed grouse, and mourning doves. Hunting for some of these species is fair. Migratory waterfowl are generally limited to the lower portion of the watershed and are not abundant. Some wood ducks and mallards nest in the area.

Other small game include skunks, foxes, coyotes, ground squirrels, silver grey squirrels, and cottontail rabbits.

Several species of furbearers inhabit the area and some of the more important include beaver, mink, otter, muskrat, and raccoons. Nutria and opossum have become very numerous in recent years and are rated as pests.

The Rock Creek drainage is similar to McKay Creek except that there are no anadromous fish located in its watershed. Urban development is encroaching upon the wildlife habitat, especially in the lower portion of the drainage, and tends to limit wildlife populations and hunting opportunities.

## ECONOMIC DATA

### ECONOMY OF THE WATERSHED

The McKay-Rock Creek project is best described as a diversified watershed in that the economic base ranges from intensive agriculture through rural and suburban residential areas (with related personal service enterprises) to light industry. Land use of the watershed is approximately as follows: fifty percent (38,107 acres) is used for agricultural production, 40 percent (30,485 acres) woodland, 8 percent (6,097 acres) residential or commercial, and 2 percent (1,524 acres) miscellaneous farmsteads and roads.

Small grains, dairy products, and beef are the principal agricultural products of the watershed. In addition, a limited amount of the beans, corn, and berries for local food processing industries and fresh produce used by the adjacent Portland metropolitan complex are produced in the watershed area. The value of farm products sold averages between \$8,000 and \$25,000 per commercial operation with a significant range between high income specialty operations and marginal part time operations. The cropping pattern consists of 57 percent forage crops, 34 percent small grains, and 9 percent vegetable, berry, or other specialty crops. Sale of farm products within this watershed averages about \$4,700,000 annually, also considerable income is derived from sale of forest products from the upper watershed.

The significance of the rural and suburban residential areas and service enterprises becomes readily apparent from an examination of the population. The present watershed population is in excess of 35,000 people of which approximately 40 percent is in urban areas, principally in the cities of Hillsboro and North Plains and in the communities of Witchhazel, Orenco, and Reedville, just east of Hillsboro. In addition to a direct effect upon the watershed economic base, the continued growth of these urban and suburban centers has been at the expense of the agricultural lands. This indirectly forces the agriculturalists to more intensive farming practices and expansion of cultivated areas to maintain income.

The light industry within the watershed includes harvesting and processing of timber products, manufacture of mobile homes and boats, food processing, and meat packing. The majority of these enterprises are concentrated in the urban areas of the lower watershed.

This watershed is within the Washington County and Sauvie Island Soil and Water Conservation Districts. Each of these districts is well established and has an active and going program of soil and water conservation.

#### LAND VALUES

Land values within the watershed are generally related to ease of cultivation and irrigation, proximity to urban centers and streets, susceptibility to flooding, and esthetic beauty (view, tree and shrub cover, and streams). Agricultural land value ranges from \$250 per acre in the steep underdeveloped upper watershed to \$1,000 per acre for intensively cropped, irrigated specialty land. In cases where the agricultural land is favorably located for urban development, the value may reach \$2,000 to \$3,000 per acre. Residential land, depending upon the location with respect to utilities, streets, and esthetic beauty, will range from agricultural land prices to as much as \$5,000 per city lot. Commercial and industrial property located near main highways and rail lines is equal to or higher in value than the better residential property.

#### LAND OWNERSHIP

The large majority of this watershed consists of privately owned lands. In addition, due to the urban areas involved, there are several areas of city, county, and state lands used for parks, memorials, maintenance areas, and office sites. The only Federal land within the watershed consists of 2,560 acres of former Oregon-California Railroad grant land administered by the U.S. Bureau of Land Management.

<u>Land Ownership</u>	<u>Percent</u>	<u>Acres</u>
Private (including miscellaneous areas of city, county, and state land)	96.6	73,653
Public Domain (BLM)	3.4	2,560
Total	100.0	76,213

There are approximately 600 farms within the watershed. Most of these are owner operated. About 200 of these are small, part time operations that average five to ten acres in size. The full time, commercial units will average from 160 to 240 acres in size. Private forest land holdings are generally less than a half section in size. A few industrial companies own a section or more.

#### T R A N S P O R T A T I O N F A C I L I T I E S

A network of all weather state and county roads provides access to all but a few limited areas in the extreme upper watershed. State Highway 26 traverses the watershed and is being improved by interstate standards.

Railroad facilities serving the watershed include the Spokane, Portland, and Seattle, the Southern Pacific, and the Oregon Electric. These companies have trackage servicing much of the lower watershed area.

Airports include Oregon's second largest facility located in Hillsboro. The Hillsboro field is equipped to handle commercial aircraft and will very likely have scheduled stops in the near future.

The watershed is served by major freight and bus lines with terminals in Hillsboro and in nearby Beaverton and Portland.

#### L A N D T R E A T M E N T D A T A

The upper area of this watershed is now primarily in woodland with some scattered areas of grassland and annual cropping. Scattered throughout the area are small pockets of residential development. The east end of the watershed is most effected by this change in use to urban or suburban development. Construction activities on the stream and erosive hill soils have caused sediment in the streams and land stabilization problems. This condition is expected to increase and special attention to land use planning and regulation will be needed. There are no critical erosion areas known to exist above project reservoirs or benefit areas. The flood plain along both McKay and Rock Creeks is mostly in woodland, brush, or grass. There are some

small areas of annual cropping. Land use changes or improvements of use can not be made on the flood plain until the hazards of flooding have been reduced. With flood protection, the flood plain will be more intensively developed for agricultural and recreational use including golf courses and similar developments.

The watershed is in the Washington and Sauvie Island SWCDs. Most of the area is in the Washington County SWCD with a small upper watershed area in the Sauvie Island District. Both SWCDs have active conservation programs and can be expected to take the necessary leadership to accomplish the land treatment and related phases of this project.

There are approximately 400 agricultural land ownerships in the watershed, of which 200 are SWCD cooperators. Conservation plans have been developed on 80 ownerships covering approximately 50% of the watershed. About 25% of the planned conservation practices have been applied.

Fire protection in the watershed area is provided by both rural and state fire protection districts. The upper forested areas of the watershed are protected by the Oregon State Forestry Department, while the lower portions, structures, and improved land generally are protected by adjacent and intermingled rural fire protection districts. Since 1950, the ratio of the area burned to the total forest area has been kept very low.

An average of one or two very small fires per year have burned in the forested part of the watershed. Increased recreation use will be primarily in developed areas around the reservoirs. Little increase in number of fires is expected and present fire protection organizations are adequate for the area.



SCS PHOTO 7-2104-8

New road cut, badly eroded. Representative of erosion and sediment problems in areas of new development.

# WATERSHED PROBLEMS

## FLOODWATER DAMAGE

Flooding is a problem in the watershed. Flooding occurs at least once a year and in eleven years out of the past 78 years significant flood damage has occurred. Eighty-eight percent of the major floods have occurred in December, January, or February with the remaining 12 percent occurring in November, March, and April. Warm rains melt the snow rapidly and the runoff of precipitation and snowmelt together causes major flooding. The duration of flooding is usually several days in the relative flat areas.

There are approximately 715 acres in the annual flood plain and 1,525 acres in the 1 percent chance event flood plain. Present flooding conditions limit the use of the agricultural land, prevent the utilization of good management practices, damage the land, and keep the productivity low. The estimated average annual direct agricultural damage is \$7,780.

Flood flows damage roads and bridges and interrupt traffic for several days. Debris removal at the many bridges is an extra maintenance cost. The estimated average annual road and bridge direct damage is \$6,660.

Commercial property damages included flooded houses, lawns, parking lots, golf courses, sewage treatment plants, and limited opportunity for improving land use. The estimated average annual urban direct flood damage is \$18,440.

Several miles of the lower reaches of both McKay Creek and Rock Creek are affected by backwater from the Tualatin River during flood runoffs on that stream.

### Erosion

Erosion rates for the watershed range from low in the heavily forested mountainous area to moderate in the rolling footslope areas of the middle watershed. Some high sediment producing areas exist where steep hillside or bench areas are under intensive cultivation and in areas of increasing activity in housing, industrial, and road construction. Local areas of streambank erosion, generally related to debris jams and vegetative overgrowth, occur along most upper and middle watershed stream channels. The following sediment yield values are representative of the area: forest lands, 0.1 acre feet per square mile per year (AF/sq.mi.); cropland (steep) and areas of new home and road construction, 0.5 AF/sq.mi.; cropland (rolling), 0.3 AF/sq.mi.;

and valley plain, 0.1 AF/sq.mi.

### Sedimentation

Sediment deposition is limited and generally related to debris or vegetative obstructions in the channels. Road ditches and slope breaks also cause deposition problems. On cropland areas, sediment deposition is mostly local on-farm field sheet deposition in swales or along field slope breaks below fallowed areas. A large percentage of the stream sediment load passes through the watershed in suspension. However, where streamflows are out of banks under flood conditions, the sediment dropout causes considerable damage to crops, drain ditches and roads. Sediment deposition increases damage and flood cleanup costs for buildings, equipment and other improvements.

## PROBLEMS RELATING TO WATER MANAGEMENT IRRIGATION

McKay and Rock Creek are typical of the low elevation streams of northwest Oregon. Winter runoff volumes are large, but flows decrease rapidly during the spring. Summer flows are over appropriated by existing water rights in the McKay-Rock Creek area and in the areas downstream along the Tualatin River.

Irrigation is limited within the area by the lack of a dependable water supply during the major part of the growing season. Any major expansion of irrigation is dependent on the development of water storage within the basin or importation of water from sources outside of the watershed.

The topography of the irrigated area, non-contiguous irrigable areas, and high land values limit the choice of water distribution and application methods.

## RURAL WATER SUPPLY

A shortage of water exists in rural areas of the watershed where well or spring water is not adequate and municipal water is not available. In some instances the shortage of water limits the spraying of orchards, watering of livestock, and growing of farm gardens and other household uses.

## D R A I N A G E

The internal drainage of the soils within the proposed irrigated area ranges from well drained to poorly drained with the larger portion of the area in the medium to somewhat poorly drained range. As irrigation water becomes available, more vegetable and small fruit crops will be grown, generally on a rotation basis with forage crops. This change will require more on-farm drainage due to plant requirements and also to improve late fall harvesting conditions.

## M U N I C I P A L   A N D   I N D U S T R I A L   W A T E R

A shortage of municipal and industrial water now exists in the Tualatin Valley. Municipal and industrial water is now being brought into the east edge of the valley from the Bull Run Watershed through the delivery system of the City of Portland. The City of Hillsboro has recently completed planning on an enlargement of their system which will import water from the Trask Watershed. Other municipalities obtain their water from springs, wells, surface sources, or a combination of these supplies.

Population trends project a large increase in the Beaverton, Aloha, and Tigard area within the next few years. This area is generally at the extreme end of the Portland distribution system and any large increase in demand could involve resizing of the Portland system from the outlet to the source at Bull Run.

Several cities and water districts are now making studies for additional sources of water for orderly future development. It is generally felt that a source located within the basin and near to the projected increase in population would be to the advantage of all concerned.

## R E C R E A T I O N

There is a very significant need for water-based recreation facilities in and adjacent to the McKay-Rock Creek Watershed area. At the present time there are no developments of this type available in close proximity to a potential recreation population of over 200,000 people residing in the northwest Portland metropolitan area. Presently, these people must drive some 20 miles across the metropolitan area or 80 miles to the Pacific coastal area to obtain day use water-based recreation facilities. The only present alternative to this situation is the use of the Willamette-Columbia riverside areas which have some limitations due to water quality and safety problems.

Over the past ten years the population within the watershed service area has more than doubled. Future projections indicate a

continuance of this trend thus compounding the present need for close-in day use recreation facilities. All local city and county groups in addition to the Metropolitan Planning Commission and the State of Oregon are on record as stressing that it is imperative to have well planned and substantial water-based recreation areas developed as soon as possible to relieve the water-based recreation pressure within the northwest metropolitan area. Existing facilities which have been developed to serve the east metropolitan area and which are similar in scope and purpose to the proposed McKay-Rock Creek developments are experiencing in excess of 400,000 visitors annually.

#### FISH AND WILDLIFE PROBLEMS

Lower summer flows and heavy irrigation demand limit fish production on McKay Creek especially below Jackson Creek. Pollution is also a problem for fish in the lower reaches of McKay Creek. Undesirable fish species may be present in the proposed impounded area and in the streams above. Coho salmon spawning area in McKay Creek is limited to the stream reaches above Collins Road where suitable stream conditions are found.

Low stream flows, heavy irrigation demand and pollution have limited resident fish production in Rock Creek. Undesirable fish species may be present in the proposed impounded area and in the streams above. Urban encroachment has resulted in a considerable loss of wildlife habitat and hunting opportunity. Some wildlife damage to crops and property occurs but is not considered serious.



SCS PHOTO F-451-2

*Flooding along McKay Creek limits land use and reduces land value.*

# PROJECTS OF OTHER AGENCIES

The Corps of Engineers, in a December, 1953 report, recommended improvement of the Tualatin River for flood control. Although economically justifiable, the work was not recommended at that time because of lack of adequate local support. The project studied would have improved the channel of the Tualatin River and lower reaches of some of the major tributary streams with its primary benefit being flood control. There is considerable interest for a reappraisal of the flood prevention program on the Tualatin River. The Corps of Engineers and SCS have been requested by local organizations to carry out a coordinated study of possible main stem and tributary improvement. This reappraisal of the program for the Tualatin is being carried out as part of the Willamette Basin Review. The McKay-Rock Creek project measures will not conflict with the Corps' project but rather will be complementary.

McKay-Rock Creek Watershed is located adjacent to the project area of the Bureau of Reclamation Tualatin project, which has been authorized and has received some small allocation of design funds. A small portion of the irrigation district formed to implement the Bureau project is located in the southwest corner of the watershed. Lands to be served by the two projects will abut but will not overlap. The Tualatin Irrigation District and the McKay Water Control District have agreed to the service area for each project and are currently adjusting their boundaries to cover these areas. The development of the watershed project will in no way decrease the effectiveness nor increase the cost of the Bureau of Reclamation project. Either of these projects could be installed completely independently of the other. However, development of the two projects concurrently will give extra encouragement to processing plant development and other project-related economic activity in the area.

# BASIS FOR PROJECT FORMULATION

## PROJECT FORMULATION

### PROJECT OBJECTIVES

The project formulated for the McKay-Rock Creek Watershed will as nearly as possible meet the objectives desired by the local sponsors which can be included within the framework of Public Law 566. The land treatment and structural measures selected for inclusion in this work plan are those that meet the project objectives at the lowest annual cost.

The objectives to be met by this project have been agreed to by both the sponsors and the Service as being adequate to provide the level of protection or development desired for each project purpose.

Project measures are planned to provide conditions for more intensive and diversified land use and to assist in the development and stabilization of the economy of the area. Consideration was given to all other water resource plans existing or being planned for this watershed and the adjacent areas to assure that elements of this plan will be compatible with full development of the entire region.

The objectives of the project are to provide, with a multiple-purpose project development, a combination of land stabilization, flood prevention, recreation, municipal-industrial water supply, irrigation, and rural water supply benefits.

The flood prevention measures will obtain the objective of providing the maximum justifiable level of flood protection:

For McKay Creek by providing protection against a 20 percent chance flood event for the agricultural flood plain of 1,087 acres.

For Rock Creek by providing protection against a 1 percent chance event for approximately 10 acres of proposed intensive development and protection against a 30 percent chance event on about 413 acres of agricultural land.

The recreation objectives are to provide water-based recreational areas including high intensity recreational developments to help meet a rapidly increasing recreational demand. Recreational measures will be included to assist in meeting regional needs to the extent that facilities included can be installed and operated compatibly with

the other project purposes.

Objectives for development for Municipal and Industrial water supplies are to provide the maximum possible amount of high quality water to help meet the long term water supply needs of the watershed and adjacent areas in the northeast portion of the Tualatin Basin where there is a rapid expansion of urban and suburban development.

Project irrigation objectives are to provide an adequate full season water supply with a minimum reliability of meeting full season requirements 8 out of 10 years, for approximately 7,700 acres of cropland nearly all of which is now producing dryland crops.

Objectives for the development of rural water supply are to provide a source of water primarily for agricultural use for approximately 23 farms to meet their needs for livestock, miscellaneous farm use, and household water supplies. These farms are located in the Pumpkin Ridge area where surface water and well development are inadequate to meet their needs.

Land stabilization objectives are to reduce erosion caused soil losses from the serious sediment source areas from the present 0.5 a.f. per square mile to 0.3 a.f. or less per square mile. These areas include new construction areas, intensively cultivated hill lands, roads, ditches, and slope breaks.

## FORMULATION PROCEDURES

### Determination of Needs

Inventories were made by sponsoring local organizations with assistance of the Service and other interested agencies to determine the needs for each of the project purposes.

The inventory of irrigation needs was accomplished by an interest sign-up of landowners. The acreage planned for project water delivery was signed up for project irrigation water supplies with a financial contribution to the district in proportion to the acreage signed. The acreage to be served includes most of the irrigable land in the service area. The irrigation sign-up included the crops to be grown and the location of land to be irrigated. Land projected to change to non-agricultural use within about 20 years was not included in the project irrigation service area. The necessary reliability was determined by establishing the requirements to support economic projection of the crops to be grown with reasonable adjustment to crop acreages in dry years.

All of the municipal and industrial distribution agencies in the potential service area inventoried their present and future needs for water supplies and indicated by letter their interest in obtaining project water.

Material on recreational needs for this area was taken from planning commission and other agency reports covering recent surveys in this area. Several meetings were held with representatives of all local, State, and Federal recreation agencies to determine the nature and scope of recreation needs which could be met by this project. Inventories were also made of existing nearby recreation facilities to obtain a projection of expected recreational use.

Flood damage surveys were conducted to determine the extent of present damages. Land use projections, developed by county and regional planning commissions, the soil conservation districts, and other planning agencies were used to determine the level of flood protection necessary.

The land owners in the Pumpkin Ridge area, after considering all available sources of water supply, petitioned the project sponsors to receive water supplies for other agricultural uses from this project.

Federal land administered by the Bureau of Land Management has good cover condition and is moderately to well stocked with 20 to 30 year old coniferous reproduction with some alder component. The BLM reviewed their management plan for these lands and report that these stands are too young for commercial thinning and no treatment measures will be needed during the installation of this project.

### Selection of Measures

Land treatment measures were given the first consideration in obtaining the project objectives. Wherever the problems cannot be solved feasibly by land treatment, structural measures were considered in accomplishing the desired goal. Land treatment practices to be included were determined from technical guides developed for treatment of each soil group and land use.

Structural measures in this plan were selected on the basis of the most effective and economic combination to accomplish the multiple purposes. Several alternative combinations of measures, evaluation units, and levels of protection were investigated during planning. The final determination on the combination of measures to be included in the plan was made by the sponsors with the agreement of the Service.

Capacity for flood prevention in multiple purpose reservoirs was considered as the first structural measure alternative to meet the flood protection objectives. Wherever the flood prevention capacity would not provide the necessary level of protection or would be too costly, channel improvements were then considered.

Maximum joint use of space in the multiple purpose storage reservoirs will be used where this capacity can be scheduled for joint use and still meet the necessary reliability requirements for all project purposes. (See analyses section for explanation of joint use

operation studies.)

Inventories of project needs, the pattern of seasonal stream flows, and the availability of ground water or water from sources outside of the watershed established that storage and control of surplus winter runoff water by reservoirs is the only apparent practical method to meeting project objectives. Both McKay and Rock Creeks have alternative site locations.

The quality and volume of water available from McKay Creek permits consideration of storage on this stream which will be heavily oriented toward a water supply for both irrigation and municipal-industrial purposes.

A series of samples were taken from McKay Creek at the damsite and tested in the Oregon State Board of Health laboratory. These tests show McKay Creek water to be of high quality for recreation and irrigation uses but requiring treatment for bacteria, sediment and mineral removal to provide a high quality domestic water supply. Investigations of alternative sites were made to establish the most feasible location to store the full reliable yield of this stream. The site selected was found to be both the most physically feasible and the least costly to provide this capacity. It also is located above about 50 percent of the usable anadromous fish spawning and rearing areas, whereas the next best alternative site is below and would block all of these reaches. Recreational use of this site is included with some limitations to prevent conflict with other proposals. The municipal and industrial water supplies will require treatment; therefore, gasoline-powered boats will be kept from the reservoir and extra precautions taken for sanitation.

Rock Creek has a smaller drainage area than McKay with considerably more developments and potential developments in the watershed area. This stream is also located closer to the heavier concentration of population. For these reasons, a site on Rock Creek was considered to include flood protection, irrigation, and recreation with the principal emphasis on recreation. The water quality is judged to be very adequate for these purposes. Water supply for domestic purposes is not included in this site because of the expected concentrated use of the reservoir for recreation, the major residential and other developments that will be made in the areas surrounding the reservoir, and because of the relative shallowness of the reservoir all of which would make this water warmer and more difficult to adequately treat. The site selected on Rock Creek was chosen to provide the necessary storage with a maximum of surface area with as little as possible disruption of roads and other existing utilities.

The major pumping plant to deliver the water from McKay Reservoir is located downstream from the site to permit use of reservoir releases to maintain the necessary anadromous fish transportation, spawning, and rearing flows below the dam. The pumps will be located at the mouth of Jackson Creek where the flows from this stream can be used below this point to maintain the necessary base flows in McKay

Creek. It was found in the analysis that, if the pumps were located at the McKay dam site, the pipeline system would be considerably more expensive and a large volume of water would be lost for other project uses in order to maintain the necessary winter period base flow requirements. By putting the pumping plant downstream, these releases can be recaptured and largely used for municipal and industrial supplies during this period. The pumping plant for the Pumpkin Ridge system will pump directly from the reservoir to take advantage of the elevation of water in the storage pool. The pumping plant at Rock Creek Reservoir will pump directly from the reservoir since this reservoir is centrally located in the irrigation area and there are no downstream base flow requirements compatible with the irrigation scheduling.

Delivery of water will all be accomplished through pipeline systems. Alternatives, including open canals, were considered but were found to be incompatible with expected land use and would have higher average annual costs, particularly land rights. Application of irrigation water will be with sprinkler systems in order to obtain efficiencies necessary to make maximum use of a limited water supply.

# WORKS OF IMPROVEMENT TO BE INSTALLED

## LAND TREATMENT MEASURES

Land treatment costs listed in Table 1 are for those measures needed to provide watershed protection, land improvements, and the level of agricultural water management necessary to obtain total project benefits.

Measures to be installed on cropland include practices to provide efficient distribution and application of irrigation water and the orderly removal of excess water. Practices including drainage mains and laterals and tile drains will be used singly or in combinations. Practices such as irrigation sprinkler systems will be combined with irrigation water management to obtain efficient on-farm water application. Other practices or combinations of practices will include diversions, conservation cropping systems with cover crops, crop residue use, and pasture and hayland planting management.

Technical Guides prepared for the application of practices in the Soil and Water Conservation Districts will be used in the planning of the specific combination of practices needed on each tract of land.

Soil surveys have been completed on 54,000 acres which include nearly all of the benefit area. An additional area of approximately 22,000 acres will be surveyed prior to installation of project measures. The surveys will be made by use of going program funds used to assist the Soil and Water Conservation Districts.

Most of the land treatment measures will be installed on private agricultural land.

Treatment on other land will include critical area seedings and other land stabilization and sediment reduction practices. Technical assistance will be provided and will include design and layout of practices, planting recommendations, data on drainage and infiltration and similar technical guidelines.

Land treatment measures to be installed on private woodland include measures to provide fire prevention protective vegetative cover and to improve the productive capacity of these lands. Practices such as tree plantings, and cultural practices to maintain these plantings, will be installed on land where logging, construction, fires, or

excessive grazing have depleted ground cover. The State Forestry Department will provide the technical assistance necessary for woodland practices.

Refer to Tables 1 and 1-A of the Investigations and Analyses Section of this plan for additional details on cost distribution and other features.

## STRUCTURAL MEASURES

### ROCK CREEK RESERVOIR

Rock Creek Reservoir will be a multipurpose structure for flood prevention, irrigation, and recreation. The damsite is on Rock Creek about eight miles upstream from the mouth and one mile east of West Union, Oregon. This structure will control 19.19 square miles of the 75.75 square mile drainage area of Rock Creek.

The dam will be a homogeneous earth fill with a vertical drain in the downstream section. The dam will be 47 feet high, with a top width of 16 feet, top length of 1,625 feet, and a total embankment volume of 220,000 cubic yards. The upstream and downstream slopes will be 3:1 and 2 1/2:1 respectively. The upstream face of the dam will be protected by rock riprap down to the permanent pool elevation.

At the crest of the emergency spillway, the reservoir capacity will be 11,000 acre feet and the surface area 700 acres. The crest of the principal spillway will be at the top of the permanent recreation pool (194 ms1). The permanent recreation pool will have a surface area of 540 acres and a storage capacity of 7,132 acre feet which includes 388 acre feet of sediment storage. The 3,800 acre feet of storage between the principal spillway and the emergency spillway crests will be 100 percent jointly used with flood prevention. Of the 3,800 acre feet jointly used, 446 acre feet are for evaporation and seepage losses for the recreation pool and 3,354 acre feet are for irrigation and include evaporation and seepage losses for this use.

The centerline floodplain foundation consists of bedded alluvial deposits of clay, silt, sand, and mixtures of each. These deposits phase into deeper massive clayey silts under each abutment. The structure cutoff will consist of a core trench excavated into the impervious clay section under the floodplain.

Construction materials will be clayey silts obtained from the reservoir basin and abutments. Riprap material is available from existing quarries in the upper reservoir abutments. Filter material will be obtained from local sources.

The emergency spillway will be a two-way covered riser located near the left abutment. The two-way covered riser, conduit and SAF

basin will be located on an earth foundation and constructed of reinforced concrete. The capacity of the emergency spillway will be 2,600 cfs. The spillway will operate only when flows exceed those of the 1% event.

The principal spillway will consist of two levels of weirs on the side of the emergency spillway. The weirs will be gated for operation of the joint use storage capacity. The principal spillway release rate will be limited to 566 cfs.

One additional outlet, consisting of a gate in the end of the two-way covered riser will be provided to drain the reservoir to the level of the sediment pool. This outlet will have a capacity of 196 cfs.

A vegetated auxiliary spillway will be located in the left abutment. This spillway will have a capacity of 9,800 cfs, the routed outflow of the freeboard storm. The auxiliary spillway has a bottom width of 300 feet and a depth of 4.5 feet.

The reservoir will be cleared of trees and brush up to the crest of the emergency spillway, and the basin shaped to prevent fish entrapment during drawdown.

The two-way covered riser, SAF basin, and outlet controls will have fencing and handrails where necessary for protection of the facilities, the operator, and the general public.

Approximately 3,000 feet of county road now located in the reservoir will be abandoned. In addition, approximately 2,150 feet of Cornelius Pass and Germantown Roads will be raised above the reservoir on the existing alignment. A section of the Ross-Keeler Power Distribution Line (BPA) will also be removed from the reservoir area and be relocated outside the reservoir and recreation area.

Approximately 876 acres will be needed for the dam and reservoir, including the right-of-way strip around the reservoir to allow unimpeded access and use. The land is now all in private ownership.

See Tables 1, 2, and 3; Figures 6 and 7; and the Investigations and Analyses Section of this plan for additional details on cost distribution, design, quantities, and construction features.

#### MCKAY CREEK RESERVOIR

McKay Creek reservoir will be a multipurpose structure for flood prevention, irrigation, municipal and industrial water, and recreation. The damsite is on McKay Creek about eleven miles upstream from the mouth and about five miles north of North Plains, Oregon. This structure will control 23.50 square miles of the 67.25 square

mile drainage area of McKay Creek.

The dam will be a zoned gravel fill with a centrally located compacted earth core. The dam will be 143.6 feet high, have a top width of 36 feet, top length of 1,800 feet, and total embankment volume of 2,285,000 cubic yards. The upstream and downstream slopes will be 2.5:1 and 2:1 respectively. The upstream face of the dam will be protected by rock riprap.

At the crest of the emergency spillway, the capacity will be 21,500 acre feet and the surface area, 310 acres. At the crest of the principal spillway, the reservoir capacity will be 15,230 acre feet and the surface area, 263 acres. The recreation pool will have a surface area of 110 acres and a storage capacity of 2,200 acre feet which includes 223 acre feet of sediment storage. The mean sea level elevation at the top of the recreation pool is 270 feet. The agricultural water storage capacity includes 9,959 acre feet for irrigation and 18 acre feet for rural water supply for a total capacity of 9,977 acre feet, which includes 3,264 acre feet jointly used for flood prevention. The M&I storage is 9,193 acre feet which includes 3,006 acre feet jointly used for flood prevention. The reservoir includes 318 acre feet of capacity for storage of the 100-year sediment accumulation.

The centerline foundation consists of tuffaceous sandstone overlain by 25 to 30 feet of cobbley gravels on the floodplain. The abutments are also tuffaceous sandstone but are overlain by 20 to 90 feet of alluvial and colluvial clay cemented silts, sands, and gravels. The impervious core will be excavated through the gravels and approximately 20 feet into the sandstone beneath the floodplain section. On each abutment the core trench will be excavated about ten feet deep with a grout curtain extending from the bottom of the excavation to the sandstone surface. The depth of this curtain will vary from 10 to 100 feet to insure a positive cutoff into the impervious sandstone. Design drilling will determine the final requirements.

Construction materials for the embankment will consist of cobbley gravels from the reservoir basin, silty clays present along each reservoir abutment, and basaltic riprap material present on the upper left centerline abutment. Sufficient quantities of these materials are available for the embankment requirements.

The emergency spillway will be a drop inlet riser located in the left abutment. The riser and conduit will be placed on a sandstone foundation. The conduit will terminate in a SAF basin founded on stream gravel. The riser, conduit, and SAF basin will be constructed of reinforced concrete and will have a capacity of 6,900 cfs. The spillway will operate only when flows exceed those of the 1% runoff event.

The principal spillway will consist of three levels of ports in the end of the emergency spillway. The ports will be gated for operation of the joint use storage capacity. The principal spillway

release rate will be limited to 465 cfs.

One additional outlet will be provided to release irrigation, municipal and industrial water, and prior water right flows. Requirements for mitigative fishery facilities and stream flows for fishery purposes will also be released through this outlet. This outlet will have a capacity of 102 cfs and can be used to drain the reservoir to the level of the sediment pool to meet State permit requirements. The outlet will be located in the left abutment and will be excavated into sandstone and encased in concrete. It will have upstream and downstream control valves and will outlet into the emergency spillway SAF basin.

A vegetated auxiliary spillway will be located in the right abutment. This spillway will have a capacity of 26,000 cfs, the routed outflow of the freeboard stream. The auxiliary spillway has a 350 foot bottom width and a depth of 7.5 feet.

The drop inlet riser, SAF basin, and control outlets will have fencing and handrails where necessary for protection of the facilities, the operator, and the general public.

Measuring devices will be installed with the outlet structure to provide for accurate regulation of water released. Stage recorders will be installed above and below the reservoir to record inflow, reservoir storage releases, to meet requirements for the maintenance of streamflow and to pass streamflows required for prior rights through the reservoir.

Approximately one mile of county road now located in the reservoir will be abandoned. Approximately 2.4 miles of new road will be constructed to provide access to the area served by the abandoned road.

The reservoir will be cleared of trees and brush up to the crest elevation of the emergency spillway, and the basin shaped to prevent fish entrapment during drawdown.

A fish trapping and holding facility will be built adjacent to McKay Creek immediately below the dam. This facility will consist of a reinforced concrete holding pond, a fish ladder connecting McKay Creek to the holding pond, and a utility building. The entire area will be fenced to prevent vandalism and theft. Three stacks of fish incubator trays will also be required. These will be installed in an existing hatchery. Provision will be made in the design of the spillway riser to permit downstream migration of anadromous fish.

Approximately 407 acres will be needed for the dam and reservoir including the area around the reservoir to allow unimpaired public access and use. This area is now all in private ownership.

See Tables 1, 2, and 3; Figures 4 and 5; and the Investigation and Analyses Section of this plan for additional details on cost

distribution, design, quantities, and construction features.

## P U M P K I N   R I D G E

### P U M P S   A N D   P I P E L I N E S

The Pumpkin Ridge system will supply irrigation water under pressure to 255 acres of cropland. In addition, rural water supply for use on 26 farmsteads will be delivered to a treatment plant near Pumpkin Ridge Road about 1 mile west of McKay Reservoir.

The pumping plant will be located immediately below McKay Creek Dam and will have a capacity of 3 cfs. Intake to the pumping plant will be from the outlet conduit of the dam.

The pumping plant will include a combination of multistage turbine pumps sized to provide adequate pressure for the range of flows expected to occur throughout the delivery season. The pumps and appurtenances will be located in a building for protection of the facilities.

Approximately 11,500 feet of pipeline will be required to transport water from the pumping plant to the farm units and treatment plant. The pipeline will range in size from 12" at the pump to 4" at the last outlet. A metered outlet will be located at each farm unit. The rural water supply will be delivered from the treatment plant by a separate non-project distribution system.

## M C K A Y   C R E E K

### P U M P S   A N D   P I P E L I N E S

The McKay Creek system will supply irrigation water under pressure to 5,445 acres of cropland and deliver M&I water to a treatment plant in the West Union area.

The main pumping plant will be located immediately above the confluence of McKay and Jackson Creeks. The pumping plant will have a capacity of 96.4 cfs which will handle the combined peak requirements of the municipal and industrial and irrigation demand. The pumping bay will provide temporary storage to compensate for the time lag between releases at the dam and demands at the pump station. Additional in-line booster pumps will be installed to provide delivery pressure in the higher areas of the irrigation system.

The pumping plant will include a combination of multi-stage turbine pumps sized to provide adequate pressure for the range of flows expected to occur throughout the delivery season. The pumps and

appurtenances will be located in a building for the protection of the facilities. All intakes will be screened.

A reinforced concrete, gated diversion dam will be constructed across McKay Creek at the pumping station to control the water surface in the pump bay and help reduce operational losses. This structure will pass the 20 percent storm with the gate open. Fish passage facilities will be included to permit upstream migration of anadromous fish.

Approximately 209,500 feet of pipeline will be required to transport water from the pumping plants to the farm units and to the M&I water delivery point. Of this amount, 180,350 feet are for irrigation and 29,150 feet will be jointly used for irrigation and M&I. Where possible the pipelines will be located in the road right of way. The pipeline will range in size from 48 inch at the pump to 30 inch at the M&I treatment plant and to 4 inch at the end of the irrigation lines. A metered outlet will be located at each farm unit and M&I delivery point.

For information on location, cost distribution, quantities, and design of these water delivery measures, see the Project Map; Tables 1, 2, and 3B; Figures 8 and 9; and the Investigation and Analyses Section.

## ROCK CREEK

### PUMPS AND PIPELINES

The Rock Creek system will provide irrigation water under pressure for 2,070 acres of cropland.

The pumping plant will be located near the southwest corner of Section 18, T1N, R2W at the edge of Rock Creek Reservoir and will have a capacity of 22.8 cfs. Two in-line booster pumps will be installed to provide adequate pressure in the higher elevations.

The pumping plant will include a combination of multi-stage turbine pumps sized to provide adequate pressure for the range of flows expected to occur throughout the irrigation season. The pumps and appurtenances will be located in a building for protection of the facilities. All pump intakes will be screened.

Approximately 66,100 feet of pipeline will be required to transport the irrigation water from the pumping plant to the farm units. The pipeline will range in size from 20 inch at the pump to 4 inch at the last outlet. A metered outlet will be located at each farm unit. The pipelines will be located within the county road right of way where possible.

Fencing and handrails will be provided around pump intakes, outlet controls, pumps, motors, and other appurtenances where necessary for the protection of the facilities, the operator, and the general public. These safety features will be installed in all of the pumping units and as needed in the in-line boosters.

For information on location, cost distribution, quantities, and design of these water delivery measures, see the Project Map; Tables 1, 2, and 3B; Figures 8 and 9; and the Investigation and Analyses Section.

## CHANNEL IMPROVEMENT

Approximately 22,750 feet of the McKay Creek channel will be improved by clearing and snagging so that with the reservoir installed a 20 percent chance flood will be contained within banks. Approximately 17,790 feet of the Rock Creek channel will be improved by clearing and snagging so that with the reservoir installed a 30 percent chance flood will be contained within banks.

The clearing and snagging will consist of the removal of overhanging trees, brush, debris, and other obstructions from the channel.

For additional information on construction details, quantities, and cost distribution, see Tables 1 and 2, 3A and the Investigation and Analyses Section.

## RECREATIONAL FACILITIES

### Rock Creek Facilities

The recreation facility on Rock Creek Reservoir will consist of two units, designated for planning purposes as Sunset Bay (80 acres) and Bethany Ridge (60 acres), with a total area of 140 acres. This combined area is designed for an annual capacity of 400,000 visitor days with a peak day load of 10,000 visitors. The area to be developed is now private land which will be acquired by the recreation sponsor prior to installation of the facility. The areas are located to provide good accessibility and favorable use of the 540 to 700 acre reservoir area with a minimal effect from the maximum six foot reservoir drawdown.

The areas will be designed for intensive day use facilities with provisions for use by the physically handicapped and will include designated picnic areas, swimming beaches with bathhouses, swimming docks and protective log booms, playground areas, and boat launching and docking areas. A combination of asphalt and sod parking areas will be provided for a peak load of 3,000 cars and car-boat trailer combinations.

Sanitary facilities will include flush type toilets and waste water drains discharging into a public sewer main system. The system will be designed to meet the requirements of public health agencies. Water quality will be protected further by boating regulations including waste disposal set up in cooperation with the Oregon State Marine Board.

Access to the recreation areas will be provided by existing state and county highways augmented by two lane road systems within the recreation facility. Traffic control, visitor assistance, and safety features will be supervised by the recreation sponsor. The design layout of the facility will be such that future expansions can be made efficiently while maintaining the esthetic advantages of the area.

For information on amounts, costs and locations see Tables 2 and 2A, Figure 6, and Project Map.

### McKay Creek Facilities

The McKay Creek Reservoir recreation facility will be a 25 acre development emphasizing the natural features of rugged topography, woodland areas, marine fossil locations, all complemented by the 110 acre recreation pool. The development was designed for an annual capacity of 100,000 visitor days with a peak day load of 2,500 visitors. The area is presently private land which will be purchased by the recreation sponsor prior to installation of the facility. Access will be provided by improving the relocated county road to provide access to the site and recreation roads and trails constructed within the area developed. Due to the significant draw down feature of this reservoir, the site will be oriented toward a lesser intensity of use than the Rock Creek site with more emphasis on hiking, fishing, and day camping facilities.

The developed facilities will provide boat launching, picnicking and hiking areas, and limited overnight camping areas. Sanitary facilities will include flush type toilets with septic tanks and drain fields designed to protect the reservoir area. A prohibition on waste disposal from boats will also be enforced as added reservoir protection from contamination. Facilities to meet these needs will be designed in accordance with public health regulations. Power boats will be prohibited and other boating will be supervised in accordance with Oregon State Marine Board regulations.

The recreation facility area will be landscaped and will have irrigation systems installed to facilitate maintenance of vegetation.

Both reservoirs will be treated for the removal of undesirable fish species prior to the establishment of game fish by the Oregon State Game Commission. Future treatment will be applied as periodically required to protect annual stocking operations. Detailed information on amounts and costs is shown on Tables 2 and 2B. Facility locations and layout are shown on Figure 4 and on the Project Map.

# **EXPLANATION OF INSTALLATION COSTS**

## **ESTIMATED COSTS**

### **LAND TREATMENT MEASURES**

Installation costs shown in Table 1 for land treatment measures include costs for establishing the measures and for associated technical assistance for planning and applying the measures. Technical assistance included for land treatment measures to be installed includes soil surveys, conservation planning, and supervision of practice application.

Included in the total \$991,900 cost of land treatment are \$870,100 for application of land treatment measures and \$121,890. for technical assistance in planning and applying measures. Technical assistance includes \$30,460 from going program funds (\$12,860 from the Service \$7,600 from the Forest Service on fire prevention and \$10,000 from the State Forestry Department) and \$91,430 from P.L. 566 funds for the Service to assist in accelerating the rate of land treatment installation.

### **STRUCTURAL MEASURES**

#### Construction

Construction costs include the contract or force account cost for installing structural measures including the following items:

Site preparation.

Removal of all improvements which will be abandoned.

Flagmen and other protective devices such as barriers or lights required to protect workmen or the public during construction.

The cost of excavation and installation of a closed conduit crossing a road or street when it is an integral part of an overall closed conduit system. Included are approximately 109 crossings of public and private roads by project pipelines.

## -Explanation of Installation Costs-

Catwalks, handrails, fences, gates, and other safety measures at McKay and Rock Creek Reservoirs needed for the proper function and operator safety and also for the safety of the public using the recreational developments. These safety items will also be included in the McKay and Rock Creek pumping plants and at the SAF basins on both reservoirs.

Provisions for fire prevention or suppression necessary during project construction activities.

Disposal of waste materials in accordance with sound engineering design and construction principles including placing, smoothing, and revegetating excess excavated materials. Included are disposal of strippings from borrow areas or from structure foundations, debris removal from channels cleaned and snagged, and material in excess of backfill needs for pipelines.

The estimated construction costs include a contingency allowance varying from 10 to 30 percent depending upon the possibility of unforeseen construction costs. The larger contingencies were included where subsurface conditions can not be fully determined until more intensive investigations have been conducted for final design. The average contingency for all construction items is 20 percent.

### Engineering Services

Engineering services include the direct costs of engineers and other technicians (includes amounts paid under contracts to private A&E firms) for surveys, investigations, design, and the preparation of plans and specifications for structural measures including the associated vegetative work; but does not include engineering services needed in connection with the alteration, relocation, or modification of utilities or services connected with land rights acquisition. Estimated total cost of engineering services is \$451,350, which includes \$30,000 for core drilling, grout testing, and soil tests on McKay and Rock Creek Dams and funds for model tests for spillway design.

### Project Administration

Project administration costs include administrative costs associated with the installation of structural measures. Costs included for construction contract administration are \$60,000. Other project administration cost items include costs for negotiating and administering architectural or engineering services contracts, review of engineering plans prepared by others, construction layout, inspections services during construction, and administrative costs of Government representatives. (Estimated total project administration cost is \$938,300)

### Land Rights

The cost of land rights includes the costs for:

All expenditures made in acquiring land, easements, leases, and rights-of-way or their value as estimated by the local organization with the concurrence of the Service. Included are such items as the cost of subordination agreements, the cost of complying with special provisions not necessary for the proper construction, operation, or maintenance of works or improvement, and construction and engineering services directly associated with acquisition of land rights.

Changes of existing telephone, power, gas, water, sewer lines, or other utilities. The principal item will be relocation of the Bonneville Power Line around Rock Creek Reservoir.

All relocations and changes of highways and roads that are to remain serviceable after project installation including necessary engineering. Including the relocation of the road at McKay Reservoir, modification of Germantown and Cornelius Pass Roads at Rock Creek Reservoir, and resurfacing of roads over the pipeline crossings. Relocation cost for the road around McKay Reservoir will be limited to the cost to provide access equal to present conditions. All additional costs to improve the road to the recreation area will be recreation facility cost.

Relocation or reconstruction of new fences or guardrails for the protection and safety of the public except when such measures are necessary for the protection and safety of the public using the recreation developments at McKay and Rock Creek Reservoirs (cost of fences and guardrails associated with these developments includes protection around control structures, spillways, and pump houses and are classified as construction costs).

### Water Rights

The cost of water rights includes the examination, recording, and acreage fees required by the State Engineer of Oregon. Costs are included to cover the expense of preparing the necessary maps and surveys.

## C O S T   A L L O C A T I O N

All structural measures costs, except for project administration, are allocated to the purposes served. The method used for each measure will provide that each purpose shall share equitably in any resulting savings accomplished by inclusion of more than one purpose in a structure. See Table 2A for a summary of cost allocation. The methods used for cost allocation are as follows:

McKay Creek Reservoir

Construction water rights and engineering services costs are allocated by the separable cost-remaining benefit method. Construction and water rights costs are allocated 38.29 percent to municipal-industrial water, 17.37 percent to recreation, 4.26 percent to flood prevention, 40.00 percent to irrigation, and .08 percent to rural water supply. Engineering services are allocated 40.56 percent to municipal-industrial water, 17.57 percent to recreation, 4.44 percent to flood prevention, 37.36 percent to irrigation, and .07 percent to rural water supply.

Costs of land rights for this reservoir are allocated to recreation, agricultural water, and municipal-industrial water. The allocations to the combined storage purposes (agricultural water and municipal-industrial water) were made in proportion to the increment of water surface area added for these purposes in relation to the total area required for the dam and reservoir. The balance is allocated to recreation. Land rights allocated to storage purposes were divided between those purposes on a ratio of the capacity required for each. 50.86 percent of the land rights are allocated to recreation, 25.55 percent to agricultural water management, and 23.59 percent to municipal-industrial water.

Rock Creek Reservoir

Construction, engineering services, and water rights costs for this reservoir are allocated to purposes served by the use of facilities method. This method allocates costs in proportion to capacity required for each purpose. Capacity used jointly for flood protection and irrigation or recreation storage is divided 50 percent to flood prevention and 50 percent to the other purposes.

By this method these costs are allocated 21.42 percent to flood prevention, 15.25 percent to irrigation, and 63.33 percent to recreation.

Land rights are allocated to irrigation and recreation. The allocation to irrigation was made in proportion to the increment of water surface area added for that purpose in relation to the total area required for the dam and reservoir (17.12%). The remaining costs are allocated to recreation (82.88%).

McKay Pumping Plant

Costs of this structure are allocated to irrigation and municipal-industrial water supply with 50 percent of the costs divided in proportion to peak capacity and 50 percent by average annual volume. 53.9 percent of costs are allocated to irrigation and 46.1 percent to municipal-industrial water.

## -Explanation of Installation Costs-

### McKay Dual Purpose Pipeline

Costs for this structure are allocated to irrigation and municipal-industrial water in proportion to the peak design capacity required for each purpose weighted by reaches (irrigation, 51.8 percent; municipal-industrial water, 48.2 percent).

### Pumpkin Ridge Pumping Plant and Pipeline

Costs for this structure are allocated between rural water supply and irrigation on the basis of average annual volume delivered for each purpose (97.0 percent irrigation and 3.0 percent other agricultural water).

### McKay Creek Irrigation Pipelines and Rock Creek Pumping Plant and Pipelines

All costs allocated to irrigation.

### McKay Creek and Rock Creek Channel Improvement

All costs allocated to flood prevention.

### McKay Creek and Rock Creek Recreation Facilities

All costs allocated to recreation.

## C O S T   S H A R I N G

Installation costs will be shared by local sponsoring organizations and the Federal government in accordance with requirements of Public Law 566, as amended, and the Secretary's policy statement.

## L A N D   T R E A T M E N T   M E A S U R E S

Costs for installation of land treatment will be borne by the individual landowners with such assistance as may be available from the Agricultural Conservation Program or other sources of funds.

The costs of technical assistance necessary for the installation of land treatment measures will be borne by going program funds of the Service, the Forest Service and the State Forestry Department at the rate now being expended for these programs. The costs of accelerated technical assistance above the level of going program funds of the Service will be paid from P.L. 566 funds.

**-Explanation of Installation Costs-**

**S T R U C T U R A L   M E A S U R E S**

Costs will be shared as follows:

<u>Cost Item and Purpose</u>	<u>P.L. 566 Funds</u> %	<u>Other Funds</u> %
<u>Construction</u>		
Flood Prevention	100	0
Recreation	50	50
Municipal-Industrial Water	0	100
Irrigation and Rural Water Supply	50	50
<u>Engineering Services</u>		
Flood Prevention	100	0
Recreation		
Reservoirs	100	0
Facilities	50	50
Municipal-Industrial Water	0	100
Irrigation and Rural Water Supply	100	0
<u>Land Rights</u>		
Recreation		
Land Acquisition	50	50
Relocation of Improvements	50	50
Legal fees, surveys, and other related costs	0	100
All other purposes	0	100
<u>Water Rights</u>		
All purposes	0	100

Using the above percentages, the costs of individual structural measures will be shared by P.L. 566 funds and other funds as follows:

<u>Item</u>	<u>P.L. 566</u> %	<u>Other</u> %	<u>Estimated Cost</u> \$
<u>Construction</u>			
McKay Creek Reservoir	32.98	67.02	3,080,600
McKay Pumping Plant	26.95	73.05	343,540
McKay Dual Purpose Pipeline	25.90	74.10	791,360
Rock Creek Reservoir	60.71	39.29	583,300
Channel Improvement	100.00	0.00	30,970
All other measures	50.00	50.00	1,811,400

-Explanation of Installation Costs-

<u>Item</u>	<u>P. L. 566</u> %	<u>Other</u> %	<u>Estimated Cost</u> \$
<b><u>Engineering Services</u></b>			
McKay Creek Reservoir	59.44	40.56	176,100
McKay Pumping Plant	53.90	46.10	41,300
McKay Dual Purpose Pipeline	51.80	48.20	42,700
McKay Recreation Facility	50.00	50.00	10,200
Rock Creek Recreation Facility	50.00	50.00	33,400
All other structures	100.00	0.00	147,650
<b><u>Water Rights (All)</u></b>	<b>0.00</b>	<b>100.00</b>	<b>800</b>
<b><u>Land Rights</u></b>			
McKay Creek Reservoir			
Payment to landowners for about 407 acres	25.43	74.57	302,000
Cost of relocation or modification of improve- ments	25.43	74.57	207,100
Legal fees, surveying, and other related costs	0.00	100.00	15,900
Rock Creek Reservoir			
Payment to landowners for about 876 acres	41.44	58.56	1,322,850
Cost of relocation or modification of improve- ments	41.44	58.56	410,750
Legal fees, surveying, and other related costs	0.00	100.00	69,650
McKay Creek Recreational Facilities			
Payment to landowners for about 25 acres	50.00	50.00	12,000
Legal fees, surveys, and other administrative costs	0.00	100.00	500
Rock Creek Recreational Facilities			
Payment to landowners for about 140 acres	50.00	50.00	307,800
Legal fees, surveys, and other administrative costs	0.00	100.00	16,200
All other measures	0.00	100.00	26,750

See Page 2 of Table 2A for a summary of cost sharing by purposes for each structural measure.

-Explanation of Installation Costs-

Project Administration costs are assigned to the Sponsors and Service as follows:

Sponsors will bear all costs for local organization administrative cost for contract administration (including all legal fees), and will bear the following percentages of construction surveys and inspection costs: for McKay Reservoir 40.00, McKay pumping plant 46.10 and McKay Dual Purpose Pipeline 48.20.

The Service will bear with P.L. 566 funds the remaining costs for contract administration, construction surveys, and inspections and 100% of Government representatives and miscellaneous administrative costs.

**ESTIMATED OBLIGATION OF FUNDS - BY YEARS**

Fiscal Year	566 Funds		Other Funds	
	Land Treatment	Structural	Land Treatment	Structural
1	10,000	283,300	34,000	489,900
2	20,000	1,665,840	49,000	2,901,160
3	20,000	1,422,570	109,000	1,602,310
4	15,000	560,440	261,600	461,820
5	10,000	255,670	209,000	177,680
6	10,000	193,770	119,000	149,920
7	4,000	204,530	89,000	153,750
8	2,430	112,570	29,960	87,890
TOTAL	\$91,430	\$4,698,690	\$900,560	\$6,024,430

# EFFECTS OF WORKS OF IMPROVEMENT

The installation of project measures will have a major impact on the development and economy of the watershed and adjacent areas. Farm income will be improved and stabilized by the more diversified crop production. There will be a significant effect on business activity in the community both as a result of general increase in farm income and through the increased opportunities for urban and suburban development made possible by the additional water supplies. The recreation developments will both increase the economic activity and assist in providing an attractive place to live.

## LAND TREATMENT MEASURES

Land treatment measures will provide land stabilization and watershed protection on the upper watershed, reduce erosion and sediment production, and reduce the rate of runoff. Practices on cropland areas will provide a foundation for efficient and economical use of the irrigation water supplies and will improve the productivity of the land and decrease the cost of operation. Treatment on miscellaneous lands will accomplish a significant reduction of sedimentation and erosion and will improve downstream water quality.

The application of the land treatment practices is essential for the benefits of the structural measures to be fully realized.

## STRUCTURAL MEASURES

### FLOOD PREVENTION

The structural measures for flood prevention will eliminate 74 percent of the floodwater and sediment damages on McKay Creek. McKay Creek Reservoir and channel improvement are designed to control the peak flow of a 20 percent chance event from the site to U.S. Highway 26. The level of protection is limited from U.S. Highway 26 to the confluence with Dairy Creek because of backwater from the Tualatin River. The peak flow of the 20 percent chance event will be reduced from 2,000 cfs to 860 cfs at the McKay Creek Pumping Plant. The average annual acres flooded will be reduced from 606 to 197 acres. Depth and duration of flooding will be reduced on 1,087 acres involving 60 ownerships.

The structural measures for flood prevention will eliminate 80 percent of the floodwater and sediment damages on Rock Creek. Rock

Creek Reservoir and channel improvement are designed to provide protection from a 30 percent chance event from the damsite to the confluence with Beaverton Creek. Backwater from the Tualatin River limits the project protection on Rock Creek from the confluence with Beaverton Creek to the Tualatin River. The peak flow of the 30 percent chance event on Rock Creek at Beaverton Creek will be reduced from 1,400 cfs to 450 cfs, the average annual acres flooded from 187.5 to 103.5 acres; and flood damage will be eliminated for the design storm on 423 acres involving 89 ownerships.

When improvement of the Tualatin reduces the backwater condition, project measures in this plan and in the Beaverton Creek plan will provide additional benefits along lower Rock Creek and McKay Creek.

Damage and debris removal cost will be significantly reduced on eight bridges in the watershed. Future cost for replacement of road bridges will be substantially reduced because of the decreased flood hazard and the resulting smaller required capacities.

McKay Creek Reservoir will intercept 3.18 acre feet of sediment a year. Rock Creek Reservoir will intercept 4.56 acre feet of sediment a year. Downstream deposition damage will be reduced and water quality improved. Flood cleanup costs will be significantly reduced.

## AGRICULTURAL WATER MANAGEMENT

### Irrigation

Project measures will provide a full season irrigation water supply and a distribution pump and pipeline system to serve 7,770 acres with a reliability of 80 percent. In the remaining 20 percent of the time, the supply will be less than a full season supply. Project measures are based on the assumption that there will still be short supply years. During these years, which will occur to some degree less often than one year in five, the operating district will provide less than a full season supply. Individual farm operators will adjust their use of this water within their cropping systems. The nature of the crops to be grown and timing of planting dates will help permit this variation in supply without major damage to crops or serious reduction in income.

Nearly all of the acreage served will be converted from dryland cropping, including such crops as grain, grass, and legume seed, and dryland pastures, to a combination of higher value crops including irrigated hay and pasture, specialty seed crops, small fruits, and vegetable crops (see table in Investigation and Analyses section for composition of cropping systems and crop yields before and after project irrigation water is available).

Water quality tests of project water supplies show that the water will be of high quality for irrigation use.

### Rural Water Supply

In the Pumpkin Ridge unit project water will be delivered to a small treatment plant through the same pump and pipeline system delivering irrigation water. The water will be treated and delivered by a system installed by the landowners. The water will be used for livestock and other farm uses and will provide a domestic water supply for approximately twenty-three farms.

### MUNICIPAL AND INDUSTRIAL WATER

Municipal and industrial water supplies will be delivered from McKay Reservoir to a treatment plant near West Union. This water when treated will be of high quality and will be used to supplement existing supplies (now obtained primarily from wells and the city of Portland system) and to meet the additional water requirements that are developing as a result of expanding urban-suburban areas.

Approximately 125,000 people could be provided their full water needs from this source if it were used exclusively for residential use; however, since some use will be made of this water for industrial and commercial use, the number of residents who will be served by this source will be reduced in proportion to the amount used for these purposes. Of the 13,500 acre feet supplied for this purpose, 9,193 acre feet will come from storage and 4,307 acre feet will be supplied by direct diversion from McKay Creek. The total 13,500 acre feet of M&I water supply will have an 80% reliability. 20% of the years the watershed yield will not be adequate to fill the reservoir, however, the deficiency will usually be quite small. For example, approximately 12,040 acre feet from direct diversion plus storage will be available 90% of the years.

Generally any water deficiency will be known by the first of May. This will allow adequate time for adjustments in the overall municipal and industrial water supply and distribution to prevent an overdraft of this source.

### FISH AND WILDLIFE

#### McKay Creek

About one half of the anadromous fish spawning area on McKay Creek will be lost by construction of the dam and mitigative measures are proposed to compensate for this loss (see Works of Improvement).

Increased stream flows below the project should have a beneficial effect on resident and anadromous fish production. Increased waterfowl use of the reservoir area will occur. Good habitat for

resident trout and young coho salmon will be provided in the reservoir; however, sports fishing and fish production will be adversely affected by the large drawdown. The successful establishment of resident trout and coho salmon within the McKay Creek impoundment depends upon the removal of any trash fish populations in the impoundment area and in the stream system before water is impounded.

The reservoir outlet works are being designed to pass downstream migrating salmon smolts.

Cropping practice changes as a result of more irrigation water can affect some wildlife populations such as pheasants. Whether this is beneficial or harmful will vary depending upon the kinds of crops raised.

### Rock Creek

Rock Creek is being planned as a primary recreation area and the impoundment will have a very minimal drawdown. The reservoir should provide an ideal environment for resident trout or any other fish the Oregon State Game Commission should choose to stock and manage. The successful establishment of resident trout or other sport fish in the Rock Creek impoundment depends upon the removal of any trash fish populations in the reservoir area or in the stream above before the water is impounded.

The reservoir will be attractive to wintering waterfowl.

Heavy urban development around the reservoir will eliminate some wildlife habitat and hunting opportunities.

## RECREATION

The facility on Rock Creek Reservoir will provide close in, day use recreation facilities for the metropolitan population in and adjacent to the watershed. It will relieve the present situation of insufficient day use facilities available for a highly populated recreation-oriented area. The planned seasonal operation will be from May through September with some nominal use during the fall and spring months. The expected annual visitor days use will be 400,000. Peak day use initially will be approximately 10,000. The development will provide facilities for picnicking, swimming, boating, fishing, playground and athletics, group functions, and complementary concession outlets for food, equipment, boats, etc.

The McKay Creek Reservoir facility will provide water-based nature or primitive area recreation to complement the day use type development on Rock Creek. This will provide the people within the area with alternative facilities. The use season will be the same

for this development with an expected visitor days use annually at 100,000. Initial peak day use will be approximately 2,500. The development will provide facilities for picnicking, camping, geologic study, nature and hiking trails, boating, fishing, and swimming.

Both facilities will have a very favorable effect upon the community youth development programs in addition to providing attractive locations for a future community center, educational, and exhibit facility developments. These facilities will also indirectly relieve some of the recreation pressure now put upon similar developments in east and southeast Portland.

Water quality tests show that water in both reservoirs will be of high quality for recreational use.

#### I N C I D E N T A L   E F F E C T S

Both reservoirs will provide additional water supplies for fire protection.



SCS PHOTO 7-2172-5

*Project recreation facilities will provide water based recreation opportunities for many people. Primary uses will include fishing, swimming, picnicking and boating.*

# PROJECT BENEFITS

## PRIMARY BENEFITS

### LAND TREATMENT MEASURES

Benefits from land treatment measures will be primarily on-site conservation benefits accruing from more efficient management of land and water. No monetary evaluation was made for these measures.

### STRUCTURAL MEASURES

#### Flood Prevention

The primary flood damage reduction benefits resulting from the installation of project measures include \$29,280 direct benefits and \$2,900 indirect benefits. Benefits from more intensive land use will be \$7,490. Total average annual primary flood prevention benefits will be \$39,670.

#### Irrigation

Estimated average annual primary benefits from irrigation measures will be \$409,870 after deduction of associated costs.

#### Municipal and Industrial Water

Estimated average annual primary benefits from municipal and industrial water measures will be \$612,500 after deduction of associated costs.

#### Rural Water Supply

Estimated average annual primary benefits from rural water supply measures will be \$710 after deduction of associated costs.

### Recreation

The estimated benefits for the Rock Creek recreation facility are based upon a full development of an average of 400,000 visitor days at \$1.50 each for an annual benefit of \$600,000.

The estimated benefits for the McKay Creek recreation facility are based upon a slightly less than full development and an average 100,000 visitor days at \$1.25 each for an annual benefit of \$125,000.

### SECONDARY BENEFITS

Local secondary benefits will be equal to 10 percent of the increased production costs and 10 percent of the direct primary benefit. Estimated average annual secondary benefits will be \$389,700.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation and were not included in the benefit cost analysis.

### UNEVALUATED BENEFITS

The installation of the land treatment and structural measures will encourage additional interest in conservation of the resources of the watershed and will help to stabilize the economy of this area. It will also promote further capital improvements, increase employment, help maintain a higher standard of living, and contribute to the general welfare of the community and the state.

Benefits to the resident stream trout fishery, created by increases in summer streamflows, and the benefits of project water for rural fire protection have not been evaluated monetarily.

# COMPARISON OF BENEFITS AND COSTS

The ratio of average annual benefits of structural measures, \$2,177,450, to the average annual cost of these measures, \$672,990, is 3.2 to 1. This ratio is based on 1968 prices for installation costs and on adjusted normalized prices for benefits, operation, and maintenance.

The ratio without the inclusion of secondary benefits is 2.7 to 1.

Average annual costs, benefits, and comparison of benefits and costs are shown in Tables 4, 5, and 6.



SCS PHOTO 7-1260-4

# PROJECT INSTALLATION

## INSTALLATION PERIOD

The project measures will be installed progressively within an eight year period. Installation of land treatment measures will be pursued in a systematic manner during construction of the project structural measures. During the first two years of project installation, most land treatment activity will be confined to completion of soil surveys and development of conservation plans. A major portion of the application of land treatment practices for stability of the upper watershed area above project structural measures will be installed prior to installation of the structural measures. Application of measures to improve water control and distribution will be completed concurrently with the structural measures. Additional land treatment practices to allow a higher degree of management will be started prior to the installation of structural measures and completed concurrently with them.

The scheduled obligation of funds shown in the "Explanation of Installation Costs" section is based on the following proposed construction schedule:

<u>Item</u>	<u>Fiscal Year Initiated</u>	
	<u>Engineering Services</u>	<u>Construction</u>
McKay Creek Reservoir	1	2
Rock Creek Reservoir	1	3
Channel Improvement		
McKay Creek	5	7
Rock Creek	6	8
Pumping Plants & Pipelines	2	3
Recreation Facilities		
McKay Creek	3	4
Rock Creek	4	5

## INSTALLATION RESPONSIBILITIES

### LAND TREATMENT MEASURES

The installation of land treatment measures will be the responsibility of the individual landowners or operators.

Technical assistance for planning and application of land treatment measures will be furnished by the Soil Conservation Service and the State Forestry Department to the landowners or operators through the Washington County and Sauvie Island Soil and Water Conservation Districts.

It will be the responsibility of the Soil and Water Conservation Districts to obtain agreements from owners of not less than 50 percent of the land above the reservoirs that they will carry out conservation plans on their land. The Districts will also encourage the development and installation of conservation farm and ranch plans on a high percentage of the land to be benefited by project measures. They will be responsible for providing leadership in an educational program to encourage the application of land treatment measures necessary to the success of this plan. The districts will work closely with the counties, cities and other public agencies to encourage adequate land use planning, zoning, land treatment on public lands, and the inclusion of protective measures as a requirement in building and other development permits.

### STRUCTURAL MEASURES

Federal assistance for carrying out the works of improvement as described in this plan will be provided under authority of the Watershed Protection and Flood Prevention Act, P.L. 566, as amended.

Responsibilities for installation of each project measures are assigned to one sponsoring organization; however, in the installation of these measures, the sponsor with this responsibility may reach an agreement with other organizations or individuals to assist in the installation of certain measures. The responsibility for meeting all sponsorship requirements for each measure still rests with the one primary sponsor (this includes working with the Service on items of contract administration).

Following is a tabulation of installation responsibilities for structural measures:

#### Structural Unit

McKay Reservoir  
Rock Creek Reservoir

#### Sponsor with Primary Responsibilities

McKay Creek Water Control District  
McKay Creek Water Control District

Recreation Facilities

McKay Reservoir  
Rock Creek Reservoir

Washington County  
Washington County

Channel Improvement

Within McKay Creek WCD  
Other Channels

McKay Creek Water Control District  
Washington County

Pumping Plants

McKay Creek Water Control District

Pipelines

McKay Creek Water Control District

The engineering services for McKay Reservoir and for that portion of the pumping plants and pipelines which have a municipal and industrial water supply allocation will be the responsibility of the McKay Creek Water Control District. It is planned to contract for engineering services for design of these structures.

The engineering services for the recreation facilities will be the responsibility of Washington County. Service personnel will assist as available on site location, design, and supervision of construction. It is planned to negotiate for private architectural and engineering services for the major design and related engineering services necessary for installation of these facilities.

Engineering services for Rock Creek Reservoir, channel improvements, and for those pumps and pipelines which do not involve municipal and industrial water supplies will be performed by the Soil Conservation Service.

All engineering and legal services related to the acquisition of land rights including the relocation of utilities will be the responsibility of the local sponsoring organization with assigned responsibility for construction of the project measures. Assistance on these services will be obtained by agreements with the appropriate road department, utility company, other sponsor, or other agency. Washington County will assist the McKay Creek Water Control District on land appraisals and other services related to the acquisition of land rights and utility relocations for the McKay and Rock Creek Reservoirs.

The local sponsoring organizations request that the Service administer all construction contracts and negotiate and administer engineering services contracts.

P.L. 566 assistance for structural works of improvement (other than information for obtaining land, easements, and rights-of-way) will not be made available until the sponsoring local organization has acquired lands, easements, and rights-of-way or options sufficiently in advance of the scheduled installation of the works of improvement to provide a reasonable basis for the orderly design and

construction of these measures.

The following minimum conditions shall be met before issuance of invitations to bid on any portion of construction:

1. The necessary acquisition of land and easements and the relocation of utilities will be assured by the sponsors. The project sponsors have the power of eminent domain and agree to use such authority if necessary. Therefore, Federal assistance for construction may be provided before all easements and rights-of-way for the entire project are obtained. In such cases, specific agreements on obtaining all necessary land, easements, and rights-of-way shall be reached and the willingness of the sponsors to exercise their authority reaffirmed.
2. Mutual agreements on the schedule for construction and on plans and specifications shall be reached. Terms of contracts and all matters pertaining to contracts or to works of improvement shall be mutually satisfactory and in accordance with requirements of the sponsors and in agreement with the Soil Conservation Service technical and administrative requirements.
3. Full conformance with State and Federal laws and regulations shall be the responsibility of the sponsors and shall be secured with no expenditure of P.L. 566 funds. Reasonable evidence of conformity shall be presented to the mutual satisfaction of all parties.
4. Agreements for operation and maintenance of the structural measures shall be secured.

## METHODS OF INSTALLATION

The contracts for construction will be let by competitive bid and engineering contracts will be negotiated, except in cases where a formal construction contract is determined to be impractical and construction under force account can more reasonably be used. Force account operations may be used on construction elements where it is not feasible to perform sufficient engineering studies in order to prepare detailed plans and specifications. Force account may also be used where it is not practical or feasible for the local organization to provide cash for all the local share of the cost. Sponsors may in these cases be able to perform certain elements of the project work with their own force or with contributed labor, equipment, and materials in lieu of providing cash. When these conditions exist, the State Conservationist may approve force account arrangements. The provisions of the force account work will be included in the project or engineering agreement which will be mutually agreed to immediately prior to initiation of the concerned work.

# **FINANCING PROJECT INSTALLATION**

Project installation costs allocated to P.L. 566 funds will be paid from funds appropriated under the authority of Public Law 566, 83d Congress; 68 Stat. 666, as amended. This work plan does not constitute a financial document for obligation of P.L. 566 or other funds. Financial or other assistance to be furnished by the Service in carrying out the plan is contingent on the appropriation of funds for this purpose.

All sponsors have participated in cost sharing decisions and have given assurances that their share of the installation cost will be available as indicated in the plan. The McKay Creek Water Control District and Washington County are the local sponsoring organizations with responsibility for the installation of structural measures. Both have the authorities necessary to borrow or otherwise raise money to finance the local share of project costs. Their authorities include the ability to enter into contracts with the Federal Government, other sponsors, and with other agencies to obtain financial assistance.

The McKay Creek Water Control District was organized during planning for this project. The District has levied a preliminary assessment on lands of the District to pay organizational costs and for funds to assist in development of the project plan.

## **LAND TREATMENT**

The cost of land treatment measures will be borne by the individual landowners or operators with such assistance as may be available from the Agricultural Conservation Program or other funds.

Technical assistance will be provided by the Soil Conservation Service, by going program funds, and from P.L. 566 funds for accelerated assistance in excess of the going program rate.

On private forest land technical assistance will be provided by the State Forester and financing by regular program funds appropriated by the State Legislature. The Forest Service will provide technical assistance on fire prevention with regular program funds.

## STRUCTURAL MEASURES

The McKay Creek Water Control District plans to use the loan provision of Public Law 566 to finance their share of the installation cost for structures including Rock Creek Reservoir, McKay Reservoir, channel improvement, pumping plants, and pipelines. Representatives of the Farmers Home Administration have participated in meetings of the District and a preliminary application for a P.L. 566 loan of \$5,000,000.00 has been submitted to the State Director of the FHA. This amount will be adjusted as final district needs are determined. Part of these funds will be used to acquire land rights on approximately 1,565 acres of land including 1,283 acres for the two reservoirs, 165 acres for recreational facilities, 10 acres for the pumping plants, 50 acres for the pipelines, and 57 acres for channel improvement. The District will repay this loan and obtain necessary funds for operation, maintenance, and replacement from assessments based on flood protection benefits and from contracts for purchase of irrigation, rural water supplies, and municipal and industrial water supplies. The design and specifications for the fishery facilities will be reviewed and approved by the U.S. Fish and Wildlife Service and the Oregon State Fish and Game Commissions prior to letting of the contracts for these facilities.

The District will seek financial assistance from Washington County, the Oregon State Marine Board, the Oregon State Game Commission, Tualatin Hills Park and Recreation District, on items of project installation where these agencies have interests. Agreements entered into with these agencies will be noted in the project agreements signed prior to letting contracts for structural measures.

The measures for treatment and distribution of municipal and industrial water supplies beyond the delivery point of raw water at the end of the multiple-purpose pipeline are not eligible for P.L. 566 financial or credit assistance. These measures will be financed by the distribution agency which contracts for delivery of water from McKay Creek Water Control District. These costs will be financed by a combination of grant funds from the Department of Housing and Urban Development and revenue or general obligation funds. Revenue bonds will be retired by income from sale of water.

Project installation costs allocated to Washington County will be financed from one or a combination of the following possibilities: special assessments, property tax, borrowed funds repaid by user fees or taxes, or federal and state matching funds.

Recreation and park facilities are of general or county-wide benefit and operation of these facilities will be financed from current appropriations with user fees and general taxes as resources. Capital improvements for park and recreation purposes will be financed from borrowed funds and/or current appropriations as may be available. Under Oregon law, counties may obtain long term financing from

-Financing Project Installation-

a property tax levy authorized by the voters for a fixed number of years not to exceed ten, or from general obligation bonds retired by property taxes. Maintenance and operation expenses will be financed from user fees and general taxes.

Under Oregon laws, a county can create a service district for areas of special benefit from certain functions and district costs can be financed by direct assessment to the property within the district service area. The assessments can be bonded, if desired, by property owners and repaid over ten years with interest. Flood prevention, channel improvements, and drainage facilities typically requires this method of financing as they do not have county-wide benefits sufficient to justify county general funds. Washington County has initiated proceedings to organize a service district of this type.

# PROVISIONS FOR OPERATION, MAINTENANCE AND REPLACEMENT

## LAND TREATMENT

Land treatment measures will be maintained by the landowner or operator. Technical assistance will be provided by the Soil Conservation Service and the Oregon State Forestry Department through the going programs of assistance to the Soil and Water Conservation Districts.

## STRUCTURAL MEASURES

The operation and maintenance of the recreation facilities and of the channel improvements outside the boundaries of the McKay Creek Water Control District will be the responsibility of Washington County.

The operation and maintenance of all other structural measures will be the responsibility of the McKay Creek Water Control District.

Inspections of these works of improvement will be made annually and after a major flood for the first three years of operation by representatives of the Soil Conservation Service and the sponsors. The inspections will be made by representatives of the sponsors after the third year.

Specific operation and maintenance agreements between the sponsors and the Soil Conservation Service will be executed before each land rights agreement or project agreement is executed.

Operation and maintenance of the structural measures shall conform to all appropriate local, state, and Federal regulations. Representatives of the Federal, state, and local governments shall have free access at all times to the structural measures for official activities.

Operation of the structures shall include, but not be limited to:

1. Operating the Rock Creek Reservoir for flood prevention, irrigation,

and recreation and the McKay Reservoir for these purposes plus rural and municipal-industrial water supplies. The operation includes programming the reservoir releases to obtain flood prevention benefits and to fill the storage capacity. The storage capacity to be jointly used for water supply and flood prevention will be left vacant until the hazard of major floods has passed and will then be filled according to a specific plan which will be detailed in the O&M agreement entered into between the District and the Service prior to construction of the reservoir. The stored waters will not be withdrawn below the elevation of the recreation pool (elevation 270 msl for McKay Reservoir and 194 ms<sub>l</sub> for Rock Creek). The local organization is responsible for notifying the Soil Conservation Service through the State Conservationist whenever the reservoir is operated differently than the specified ranges and jointly with the Service determine if there is a continuing need to do so.

2. Operating pumps and controls to regulate flows in the distribution systems to meet water supply needs.
3. Removing the debris from the reservoirs and from distribution system structures.
4. Operating the recreational facilities associated with the McKay and Rock Creek Reservoirs. The recreation developments, including use of the reservoir area and associated recreational facilities, will be operated by Washington County for use of the general public.

Operation of these facilities will include necessary custodial, policing, sanitation, and safety services. The operation of the reservoirs for recreation will be planned in consultation with the Oregon State Game Commission and the Oregon State Marine Board to assure compatibility of fishing and boating with other proposed uses. Power boat regulations will be exercised when conditions require controls. Disposal of waste materials from boats will be prohibited.

Washington County will enter into an operation and maintenance agreement with the Water Control District for operation of the reservoirs for recreational use prior to letting of construction contracts.

Admission and use fees may be charged for portions of the recreational development. The schedule of admission and use fees together with other requirements for operation and maintenance of the recreation facilities must be mutually agreed to by the sponsors and the Service and set forth in the operation and maintenance agreement. Prior approval by the Farmers Home Administration must also be obtained if watershed loan funds were obtained for the recreation facilities and such funds are expected to be repaid from project revenue.

Washington County and the Water Control District will enter into an agreement with the Oregon State Game Commission for operation and maintenance of the reservoir fisheries.

The state and local public health agencies will be consulted with on the plans for operation of the recreation facilities to help assure that operations will meet adequate health standards.

5. Operation of anadromous fish mitigation facilities at McKay Creek Reservoir will include all functions necessary to trap and hold adult fish; hatchery operations (both at the dam and at a designated hatchery) to handle eggs obtained from trapped fish; and the rearing and release of small fish. The McKay Creek Water Control District will be responsible for operation of mitigation facilities. The District expects to contract with the State Fishery agencies for actual performance of the work.

Maintenance of facilities shall include, but not be limited to:

1. Keeping all structures in serviceable condition by making replacements and repairs as needed.
2. Maintaining adequate capacity in natural and constructed channels by controlling weeds and undesirable tree growth, removal of sediment accumulation, and removal of debris jams.
3. Check the pipelines and appurtenances after each irrigation season; make the necessary repairs including replacement of eroded earth cover.
4. Removal of sediment from water control and pump structures to maintain required capacities.
5. Maintaining vegetative cover and rock riprap where needed.
6. Maintaining the recreational facilities. Maintenance will include keeping all facilities including roads, parking areas, and boat launching ramps in serviceable condition by making repairs and replacements as needed.
7. Maintenance of the reservoir fishery by periodic restocking and chemical treatment as necessary.

Estimated Annual Operation, Maintenance, and Replacement Costs

<u>Structure</u>	<u>Estimated Annual 1/</u>
Mckay Creek Reservoir	19,150
Rock Creek Reservoir	4,350
Pipelines, pumps, and control structures	64,860
Recreation facilities	81,780
Channel improvement	1,440

1/ Adjusted normalized prices.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

McKay-Rock Creek Watershed, Oregon

		Page 1 of 2		
		1 /		
Installation Cost Item	Unit	Number 2 /	P. L.	Estimated Cost (Dollars)
			Funds	Total
<u>LAND TREATMENT MEASURES</u>				
Soil Conservation Service				
Cropland	Acres	26,000	0	598,900
Other Land	Acres	4,000	0	56,000
Technical Assistance	-	-	91,430	104,290
<u>Subtotal - SCS</u>			91,430	759,190
Forest Service				
Woodland	Acres	3,600	0	177,200
Fire Prevention	Acres	19,000	0	38,000
Technical Assistance	-	-	0	17,600
<u>Subtotal - FS</u>			0	232,800
<u>TOTAL LAND TREATMENT</u>			91,430	900,560
<u>STRUCTURAL MEASURES</u>				
<u>Construction</u>				
Soil Conservation Service	No.	2	1,370,160	2,293,740
Multiple Purpose Reservoir	No.	1	92,600	250,904
Multiple Purpose Pumping Plant	No.	2	56,740	56,760
Agric. Water Mgt. Pumping Plants	No.	2	204,960	586,400
Multiple Purpose Pipeline	Lin. Ft.	29,150	630,450	630,450
Agric. Water Mgt. Pipelines	Lin. Ft.	257,450		1,260,900

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST  
McKay-Rock Creek Watershed, Oregon

Page 2 of 2					
Installation Cost Item	Unit	Number <u>2/</u>	P. L. 566 Funds	Other Funds	Estimated Cost (Dollars) <u>1/</u>
<u>Construction (cont'd)</u>					
Channel Improvements	Lin. Ft.	40,540	30,970	0	30,970
Recreational Facilities	No.	2	218,500	218,500	437,000
Subtotal - Construction	-	-	2,604,380	4,036,790	6,641,170
Engineering Services	-	-	318,550	132,800	451,350
Project Administration	-	-	767,960	170,340	938,300
<u>Other Costs</u>					
Land Rights	-	-	1,007,800	1,683,700	2,691,500
Water Rights	-	-	0	800	800
Subtotal - Other	-	-	1,007,800	1,684,500	2,692,300
TOTAL STRUCTURAL MEASURES	-	-	4,698,690	6,024,430	10,723,120
TOTAL PROJECT	-	-	4,790,120	6,924,990	11,715,110

1/ 1968 Price Base.

August 1969

2/ All works of improvement will be installed on Non-Federal land.

## TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(AT TIME OF WORK PLAN PREPARATION)

McKay-Rock Creek Watershed, Oregon

Measures	Unit	Applied To Date	Total Cost <sup>1/</sup>
			\$
<u>LAND TREATMENT</u>			
Conservation Cropping System	Acres	8,000	12,000
Cover and Green Manure	Acres	800	14,400
Crop Residue Use	Acres	8,000	12,000
Fishpond Management	No.	7	700
Grass and Legumes in Rotation	Acres	4,000	6,000
Grass Waterways	Acres	20	2,000
Irrigation Sprinkler System	No.	30	77,430
Irrigation Water Management	Acres	1,000	2,000
Land Clearing	Acres	300	67,500
Drainage Mains and Laterals	Lin. Ft.	39,000	23,400
Tile Drains	Lin. Ft.	900,000	270,000
Pasture and Hayland Management	Acres	2,000	3,000
Pasture and Hayland Planting	Acres	1,000	58,000
Woodland Pruning	Acres	15	600
Woodland Thinning	Acres	50	2,000
Woodland Weeding	Acres	15	300
Tree Planting	Acres	100	5,000
<u>STRUCTURAL MEASURES</u>			
Multiple Purpose Dam	No.	7	28,000
Irrigation Storage Reservoir	No.	6	24,000
Stream Channel Improvement	Lin. Ft.	10,000	20,000
Clearing and Snagging	Lin. Ft.	1,000	750
<b>TOTAL</b>			<b>629,080</b>

1/ 1968 Price Base.

August 1969

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION  
McKay-Rock Creek Watershed, Oregon  
(Dollars) 1/

Item	Installation Cost			P.L. 566 Funds			Construction Cost			Other Funds			Total
	Construction	Engineering	Land	Total	Construction	Engineering	Land	Rights	Water	Total	Other	Installation Cost	
McKay Cr. Res.	1,016,060	104,680	129,500	1,250,240	2,064,540	71,420	395,500	500	2,531,960	3,782,200			
Rock Cr. Res.	354,100	37,200	718,400	1,109,700	229,200	0	1,084,850	300	1,314,350	2,424,050			
McKay Pump. Pl.	92,600	22,300	0	114,900	250,940	19,000	5,000	0	274,940	389,840			
Rock Cr. Pump. Plant	40,370	13,000	0	53,370	40,380	0	0	0	40,380	93,750			
McKay Dual Pur- pose Pipeline	209,960	22,120	0	227,080	586,400	20,580	2,200	0	609,180	836,260			
McKay Irrig. Pipeline Sys.	437,900	58,900	0	496,800	437,900	0	8,700	0	446,600	943,400			
Rock Cr. Irrig. Pipeline Sys.	174,300	25,600	0	199,900	174,300	0	3,650	0	177,950	377,850			
McKay Channel Improvement	18,640	1,850	0	20,490	0	0	3,400	0	3,400	23,890			
Rock Cr. Chan. Improvement	12,330	1,200	0	13,530	0	0	2,300	0	2,300	15,830			
Pumpkin Ridge Pump. Plant	16,370	5,000	0	21,370	16,380	0	0	0	16,380	37,750			
Pumpkin Ridge Pipeline	18,250	4,900	0	23,150	18,250	0	1,500	0	19,750	42,900			

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION  
McKay-Rock Creek Watershed, Oregon  
(Dollars) 1/

Item	Installation Cost P.L.			566 Funds			Installation Cost			Other Funds			Total
	Construction	Engineering	Land Rights	Total	Construction	Engineering	Land Rights	Water Rights	Total	Other	Cost		
McKay Recreation Facility	51,050	5,100	6,000	62,150	51,050	5,100	6,500	0	62,650	0	124,800		
Rock Creek Recreation Facility	167,450	16,700	153,900	388,050	167,450	16,700	170,100	0	354,250	692,300			
Subtotal	2,604,380	318,550	1,007,800	3,930,730	4,036,790	132,800	1,683,700	800	5,854,090	9,784,820			
Project Administration				767,960					170,340	938,300			
TOTAL				4,698,690					6,024,430	10,723,100			

1/ 1968 Prices

August, 1969

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY  
 McKay-Rock Creek Watershed, Oregon  
 (Dollars) 1/

Page 1 of 2

Item	Cost Allocation					
	Flood Prevention	Irrigation	Rural Water Supply	Recreation	M&I	Total
McKay Creek Reservoir	138,920	1,432,410	2,740	833,120	1,375,010	3,782,200
Rock Creek Reservoir	132,860	403,450	--	1,887,740	--	2,424,050
McKay Pumping Plant	--	210,200	--	--	179,640	389,840
Rock Creek Pumping Plant	--	93,750	--	--	--	93,750
McKay Dual Purpose Pipeline	--	433,180	--	--	403,080	836,260
McKay Creek Irrigation Pipeline System	--	943,400	--	--	--	943,400
Rock Creek Irrigation Pipeline System	--	377,850	--	--	--	377,850
Pumpkin Ridge Pumping Plant	--	36,620	1,130	--	--	37,750
Pumpkin Ridge Pipeline	--	41,600	1,300	--	--	42,900
McKay Creek Channel Improvement	23,890	--	--	--	--	23,890
Rock Creek Channel Improvement	15,830	--	--	--	--	15,830
McKay Recreational Facilities	--	--	--	124,800	--	124,800
Rock Creek Recreational Facilities	--	--	--	692,300	--	692,300
TOTAL	311,500	3,972,460	5,170	3,537,960	1,957,730	9,784,820

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY  
 McKay-Rock Creek Watershed, Oregon  
 (Dollars) 1/

Page 2 of 2

Item		COST SHARING									
		P. L. 566	Rural	Flood:	Irriga-	M&I	Total				
		Irrigation	Recrea-	Total	Pre-ven-	Water	Water				
		Supply	tion		tion	Supply					
McKay Res.	138,900	682,060	1,300	427,980	1,250,240	20	750,350	1,440	405,140	1,375,010	2,531,960
Rock Cr. Res.	132,800	50,200	--	926,700	1,109,700	60	353,250	--	961,040	--	1,314,350
McKay Pump. Pl.	--	114,900	--	--	114,900	--	95,300	--	--	179,640	274,940
6 Rock Cr. Pump. Pl.	--	53,370	--	--	53,370	--	40,380	--	--	--	40,380
McKay D. P. Pipeline	--	227,080	--	--	227,080	--	206,100	--	--	403,080	609,180
McKay Irr. Pipeline	--	496,800	--	--	496,800	--	446,600	--	--	--	446,600
Rock Cr. Irr. Pipeline	--	199,900	--	--	199,900	--	177,950	--	--	--	177,950
P. R. Pump. Plant	--	20,730	640	--	21,370	--	15,890	490	--	--	16,380
P. R. Pipeline	--	22,450	700	--	23,150	--	19,150	600	--	--	19,750
McKay Channel Imp.	20,490	--	--	--	20,490	3,400	--	--	--	--	3,400
Rock Cr. Chan. Imp.	13,530	--	--	--	13,530	2,300	--	--	--	--	2,300
McKay Rec. Facil.	--	--	--	62,150	62,150	--	--	--	62,650	--	62,650
Rock Cr. Rec. Facil.	--	--	--	338,050	338,050	--	--	--	354,250	--	354,250
TOTAL	305,720	1,867,490	2,640	1,754,880	3,930,730	5,780	2,104,970	2,530	1,783,080	1,957,730	5,854,090

1/ 1968 Price Base

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## TABLE 2B - RECREATION FACILITIES

ESTIMATED CONSTRUCTION COST  
(Dollars) 1/

McKay-Rock Creek Watershed, Oregon

Item	Estimated:			Page 2 of 2	
	: Unit	: Unit	: Number	: Construc-	: Construc-
	: Cost	: Cost	: Number	: Construction Cost	: Construction Cost
Signs	Lump			1,000	500
Access Road Improvement	Lump				24,000
Public Water Supply System	Lump			28,450	5,750
Power Facilities	Lump			2,200	350
Subtotal				304,500	101,925
Contingencies				30,400	10,175
TOTAL				334,900	102,100

1/ 1968 Prices.

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TABLE 3 - STRUCTURE DATA

## MULTIPLE PURPOSE RESERVOIRS

## McKay-Rock Creek Watershed, Oregon

Page 1 of 2

<u>Item</u>	<u>Unit</u>	<u>McKay Creek</u>	<u>Rock Creek</u>	<u>Total</u>
Class of Structure	"c"	"c"	"c"	
Drainage Area	Sq. mi.	23.50	19.19	42.69
Curve Number (1 day)		79	84	
Tc	Hrs.	4.3	8	
Elevation Top of Dam	Ft. (msl)	375	210	
Elevation Crest Emergency Spillway	Ft. (msl)	360	200	
Elevation Crest Principal Spillway	Ft. (msl)	338	194	
Maximum Height of Dam	Ft.	143.6	47	
Volume of Fill	Cu. yds.	2,285,000	220,000	2,505,000
Total Capacity	Ac. ft.	21,500	11,000	32,500
Irrigation Storage <u>1/</u>	Ac. ft.	9,959	3,354	13,313
M&I Storage <u>1/</u>	Ac. ft.	9,193	0	9,193
Rural Water Supply	Ac. ft.	18	0	18
Recreation Pool	Ac. ft.	2,200 <u>2/</u>	7,132 <u>2/</u>	9,332
Recreation Losses	Ac. ft.	35	446	481
Aerated Sediment	Ac. ft.	95	68	163
Submerged Sediment <u>3/</u>	Ac. ft.	223	388	611
Retarding Capacity	Ac. ft.	6,270	3,800	10,070
Surface Area	Ac.	50	100	150
Sediment Pool	Ac.	310	700	1,010
Floodwater Pool at Crest of Emergency Spillway	Ac.	310	700	1,010
Irrigation Pool	Ac.	110	540	650
Recreation Pool	Ac.	310	0	310
M&I	Ac.			

TABLE 3 - STRUCTURE DATA

## MULTIPLE PURPOSE RESERVOIRS

McKay-Rock Creek Watershed, Oregon

Page 2 of 2

<u>Item</u>	<u>Unit</u>	<u>McKay Creek</u>	<u>Rock Creek</u>	<u>Total</u>
Principal Spillway				
Rainfall Volume (areal)	(1 day)	In.	5.38	5.25
Rainfall Volume (areal)	(10 day)	In.	13.75	13.75
Runoff Volume (10 day)		In.	11	11.7
Capacity	cfs		465	566
Frequency of Operation of Emergency Spillway	%	1	1	1
Emergency Spillway				
Rainfall Volume (ESH)	(areal)	In.	8.80	9.40
Runoff Volume (ESH)		In.	6.26	7.45
Type		Drop Inlet riser		Two-way covered riser
Crest Length	Ft.	130	150	
Velocity of Flow (Ve)	Ft./sec.	45	30	
Maximum Water Surface Elevation	Ft.	367.5	205.5	
Freeboard Spillway				
Rainfall Volume (FH)	(areal)	In.	19.20	20
Runoff Volume (FH)		In.	16.34	17.88
Type		Earth		Earth
Crest Length	Ft.	350	300	
Maximum Water Surface Elevation	Ft.	375	210	
Capacity Equivalents				
Sediment Volume	In.	0.25	0.45	
Retarding Volume	In.	5	3.71	
Spillway Storage	In.	3.67	7.82	

1/ Includes assigned share of evaporation and seepage losses.

2/ Includes the submerged sediment.

3/ Joint use with storage purposes.

August 1969.

TABLE 3A - STRUCTURE DATA - CHANNELS

## McKay-Rock Creek Watershed, Oregon

Channel Name	Location	Drainage Area : sq.mi.	Design Capacity : cfs	Hydraulic Gradient : ft./ft.	Channel Dimensions : Cross-Sec-tional Area : sq.ft.	Wetted Perimeter : ft.	Velocity 2/ : ft./sec.	Type of Improvement 1/
McKay Creek	Dixie Mountain Road Crossing	3.9	400	0.00080	220	100	1.80	C & S
	Above Jackson Creek	6.6	780	0.00100	277	75	2.82	C & S
	Midway between Jackson Creek & S.P.&S. RR	13.6	900	0.00063	341	73	2.63	C & S
	Above U. S. 26	15.1	1000	0.00033	370	46	2.70	C & S
Rock Creek	Highway U. S. 26	3.5	350	0.00100	137	42	2.60	C & S
	Cornell Road	3.9	350	0.00020	274	70	1.30	C & S
	Oregon Electric Railroad	4.0	480	0.00130	152	41	3.2	C & S

1/ C &amp; S - Clearing and Snagging.

2/ Channel "n" value following C &amp; S is 0.040.

August 1969

## TABLE 3B - STRUCTURE DATA

## DISTRIBUTION SYSTEM

McKay-Rock Creek Watershed, Oregon

<u>Unit</u>	<u>McKay Creek</u>	<u>Rock Creek</u>	<u>Pumpkin Ridge</u>	<u>Total</u>
Area Served	5,445 Acres	2,070 Acres	255 Acres	7,770 Acres
<u>Pipe Diameter</u>	<u>Feet</u>	<u>Feet</u>	<u>Feet</u>	<u>Feet</u>
48"	8,900			8,900
45"	4,400			4,400
42"	6,750			6,750
39"	4,200			4,200
36"	3,900			3,900
33"	100			100
30" <sup>1/</sup>	900			900
20"	8,100	1,750		9,850
18"	4,750	300		5,050
16"	14,350	8,400		22,750
14"	21,500	11,950		33,450
12"	27,550	12,950	3,600	44,100
10"	14,530	6,600	3,350	24,480
8"	37,580	3,500		41,080
6-5/8"			2,050	2,050
6"	19,150	15,100		34,250
5"	18,430	4,850		23,280
4"	<u>14,410</u>	<u>700</u>	<u>2,000</u>	<u>17,110</u>
Subtotal	209,500	66,100	11,000	286,600
No. Meters	165	74	26	265
Pumping Plants by Units	Plant HP M <sub>1</sub> 3,300 M <sub>2</sub> 200 M <sub>3</sub> 5 M <sub>4</sub> 5 M <sub>5</sub> 10	Plant HP R <sub>1</sub> 810 R <sub>2</sub> 40 R <sub>3</sub> 25	Plant HP PR <sub>1</sub> 260	Plant HP
Subtotal	3,520	875	260	4,655

<sup>1/</sup> Pipeline 48" - 30" is joint use irrigation and M&I. August 1969

TABLE 4 - ANNUAL COST

McKay-Rock Creek Watershed, Oregon

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation Maintenance Cost	Total
McKay Creek	289,030	86,100	375,130
Rock Creek	168,510	85,480	253,990
Project Administration	43,870	0	43,870
GRAND TOTAL	501,410	171,580 3/	672,990

1/ Price Base: Installation 1968; O&amp;M Adjusted Normalized.

2/ 100 years @ 4-5/8 percent interest.

3/ Includes \$81,780 for operation, maintenance and replacement for the recreational developments.

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TABLE 5  
 ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS  
 McKay-Rock Creek Watershed, Oregon  
 (Dollars) 1/

Item	:	Estimated Average Annual Damage	:	Damage Reduction Benefit
	:	Without Project	:	With Project
<u>Floodwater and Related Sediment</u>				
Crop and Pasture		3,310	910	2,400
Other Agricultural		4,470	1,450	3,020
Roads and Bridges		6,660	0	6,660
Commercial		18,440	1,240	17,200
Subtotal		32,880	3,600	29,280
<u>Indirect</u>		3,300	400	2,900
<b>TOTAL</b>		<b>36,180</b>	<b>4,000</b>	<b>32,180</b>

1/ Adjusted Normalized Prices.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

McKay-Rock Creek Watershed, Oregon

(Dollars) 1/

Evaluation Unit	Damage: Reduc- tion	More Intensive Land Use:	Rural Irriga- tion	Municipal Water Supply:	Recrea- tion Supply:	Second- ary Supply:	Average Annual Benefits <u>1/</u>	Total	Average Benefit/ Annual Cost Ratio <u>2/</u> :	
McKay Creek	6,160	5,530	300,680	710	612,500	125,000	277,260	1,327,840	375,130	3.5:1
Rock Creek	26,020	1,960	109,190	0	0	600,000	112,440	849,610	253,990	3.3:1
Project Administration	0	0	0	0	0	0	0	0	43,870	0
GRAND TOTAL	32,180	7,490	409,870	710	612,500	725,000	389,700	2,177,450	672,990	3.2:1

1/ Adjusted Normalized Prices.

2/ From Table 4.

August 1969

*Investigations  
and  
Analyses Section*

MCKAY-ROCK CREEK  
WATERSHED WORK PLAN

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# INVESTIGATIONS

## HYDROLOGY

Hydrologic investigations were made to determine peak flows, annual yields, runoff patterns, 10-day runoff volumes, occurrence of flooding, precipitation data and evaporation data for use in planning multiple purpose reservoirs, stream channel improvements and irrigation measures.

Principal sources of data used in these investigations include: streamflow data, U.S. Geological Survey Water Supply Papers and State of Oregon Surface Water Records; and climatological data, U. S. Weather Bureau Climatic Summaries, Technical Papers, Hydrometeorological Reports and State of Oregon Precipitation Records.

Soils information was obtained from current soil surveys being conducted by the Soil Conservation Service. Land use was obtained from information developed by the Soil Conservation Service, aerial photos and topographic maps.

## GEOLOGY

### SURFACE INVESTIGATIONS

Surface investigations include a survey of the regional geology and detailed, limited-area geologic mapping of structure centerlines, reservoir areas, and borrow locations. The generalized watershed map was prepared from previous reports by other agencies with additional field checks at selected locations and is intended to show the overall watershed geology as it relates to the project structures, ground water conditions, sedimentation, and construction materials.

Detailed structure site geologic maps were prepared for structure design and borrow location. These maps were prepared on aerial photographs and large scale topographic maps. Geologic data was obtained from rock outcrops, road cut exposures, geomorphic patterns, previously published material, and stereographic interpretation of aerial photographs.

## S U B S U R F A C E I N V E S T I G A T I O N S

Information on subsurface conditions was obtained by core drilling operations, backhoe excavation, and seismic and resistivity surveys. Centerline structure cross sections were developed from these data to show stratigraphy, structure, weathering, permeable zones, and overall foundation rock conditions. These were then used as a basis for foundation design, hydraulic cutoff, and grouting analysis.

Drilling operations included four core holes on the abutments and floodplain section of the McKay Creek site slightly downstream from the present centerline. These holes were pressure tested with both holding and flow tests. Penetration tests were made and core and push tube samples were recovered and tested for permeability and mechanical composition. Continuous grab samples were also obtained. On the Rock Creek site, three auger holes were completed to depths of 35 feet with undisturbed samples obtained and tested for permeability, mechanics, and stability.

Backhoe operations included 10 pits excavated along the McKay Creek centerline and borrow area and one pit on the Rock Creek site centerline. Both disturbed and undisturbed samples were obtained for laboratory analysis. These pits varied from 5 to 18 feet in depth and exposed the upper alluvial sections, water table levels, and seepage rates.

Seismic and resistivity surveys were made along the abutments and floodplain sections of both dam sites to extend drill hole information.

## C O N S T R U C T I O N M A T E R I A L S I N V E S T I G A T I O N

Construction materials investigations included backhoe excavations and auger holes on both McKay Creek and Rock Creek damsites. Borrow areas were sampled at selected locations and laboratory analyses were made of permeability, strength, and mechanical size ranges. Quarry rock estimates were made from outcrop examinations and local quarry operations. Quality and quantity of all required materials were determined from these investigations to provide a basis for project design and cost analysis.

## S E D I M E N T A T I O N I N V E S T I G A T I O N S

Sediment yield rates for the watershed were obtained from values listed by Flaxman and High (1955, Sedimentation in Drainage Basins of the Pacific Coast States) with additional field observations in selected areas. Interviews were also conducted with local stock-pond owners to determine local area yield rates. Sediment deposition

was located by visual inspection of the floodplain areas and from interviews with farm operators.

## GROUND WATER INVESTIGATIONS

Present ground water production and future development potential within the watershed was examined to evaluate this source of water. Records and logs of existing wells were examined to determine yield rates, production zones, and drawdown conditions. Additional information was obtained from current ground water publications describing the watershed area.

## ENGINEERING

### RESERVOIR SURVEYS

The following surveys were made to develop data for planning the reservoirs proposed in this plan. 7-1/2 minute U.S. Geological Survey quadrangles were used for area capacity determinations on all but the McKay Reservoir. A U.S. Corps of Army Engineers topographic map was used for the McKay site.

Vertical and horizontal control was set on both McKay and Rock Creek Reservoirs for use with standard Agricultural Stabilization and Conservation Service photography. A Kelsh map with a 10 foot contour interval and a horizontal scale of 1 inch = 400 feet was plotted to be used for abutment conformation and a land rights map for the McKay Creek Reservoir. A topographic and land rights map with a scale of 1" = 200' and a contour interval of 2' was obtained for the Rock Creek site by a contract with a private consulting photogrammetrist.

Centerline profiles were run on the following reservoirs for fill computations:

Upper Rock Creek  
Lower Rock Creek

McKay Creek  
Bendemeer Site

### CHANNEL SURVEYS

Differential levels and cross sections were run on the major stream channels for use in computer flood flow analysis and to verify the floodplains shown by the geomorphology studies. Test data on channel bank soils was used in velocity design requirements.

## IRRIGATION

Development of the irrigation program is based on data obtained from field measurements, streamflow and meteorological records, interviews with Soil Conservation Service and Extension Service staffs in Washington County, landowners and irrigators, and the State Watermaster and his deputies for this area.

Intake rates under sprinkler application conditions were checked on the major soil groups. This analysis was made by using catch cans and manually adjusting the application rate where necessary.

Moisture holding capacity of the major soil groups was determined by obtaining 1/3 and 15 atmosphere moisture contents and bulk density values from laboratory analyses of representative soil samples.

The surveys of irrigation interest have been taken by the McKay Creek Water Control District. The second survey was completed in 1967. A contribution of \$1.00 per acre to be irrigated was asked for during the second survey to insure a firm signup. As a result of this signup, the Water Control District has indicated that the project irrigated area will be about 7,770 acres.

A pipeline distribution system serving the area reflected in the signup was prepared for cost estimating purposes. It is recognized that the system may change when the actual irrigation contracts are let. The entire irrigated area is covered by U.S. Geologic Survey 7-1/2 minute topographic sheets which were used in designing the pipeline distribution system. No additional field surveys were needed.

## MUNICIPAL AND INDUSTRIAL WATER

An M&I water interest survey was conducted by the McKay Creek Water Control District. Several of the potential municipal users expressed an interest in M&I water from this source and asked the Wolf Creek Highway Water District to represent the M&I users at future meetings of the Water Control District.

Consultants employed by the Wolf Creek Highway Water District gave estimates of the M&I water required, a peak demand rate, and estimates of yearly distribution by months.

At the request of the McKay Creek Water Control District, the Oregon State Sanitary Authority completed several water quality analyses tests on samples from McKay and Rock Creek to determine the adequacy of these sources for M&I water and to establish the extent of treatment needed.

Additional investigations for sources of M&I water on an area-wide basis have been prepared by private consulting firms at the request

of Washington County and the Columbia River Association of Governments. These investigations included other sources than the McKay Reservoir. The reports for these studies show that the McKay-Rock Creek plan is compatible with the overall plans being developed for this region.

## RURAL WATER SUPPLY

Several potential users of this water requested that the McKay Water Control District Board of Supervisors consider including capacity in McKay Reservoir for this purpose. The Water Control District then conducted a survey to determine the interest and need for this water.

## RECREATION

In view of the size and scope of the project recreation developments, detailed investigations and comparisons were made to determine project needs, site potential, site utilization, and access and expected visitor day use. Coordination throughout these investigations was maintained with appropriate Service recreation specialists, recreation sponsors, Washington County and Tualatin Hills Park and Recreation District, and other city, county, and state recreation departments. Records and reports from these groups provided the size and location of present and future recreation populations, use and cost data of comparable sites, recreation orientation of local populations, and the present and future recreation needs of the area.

Detailed comparison data was obtained from the Multnomah County Division of Parks and Memorials on Blue Lake Park which is similar in size, scope, and location (with respect to the metropolitan population) to the Rock Creek facility. Multnomah County also provided data on their Ox Bow Park and the State of Oregon provided data on State Parks, which are similar in type and nature to the McKay Creek facility.

On site investigations were made to determine facility feasibility with respect to topography, exposure, landscape adaptation, draw-down effect, and access. Design and layout data was obtained from current Service technical publications and local recreation planning group files. These were supplemented by the judgement and experience of local, state, and federal planning specialists in the field of recreation.

## ECONOMICS

### Flood Damage Surveys

Damage surveys were made by personal interviews with landowners and operators along McKay Creek and Rock Creek. The surveys included agricultural and commercial areas. Additional information was developed

to determine the extent of damages and benefits that would accrue to roads and bridges in the McKay Creek and Rock Creek drainages.

### Crop Budgets

Single enterprise crop budgets were used to determine net farm income per acre for the crops to be grown in the watershed. Data for the budgets was furnished by local farmers, the Extension Service, the Willamette River Basin Survey, and a food processing company. The costs used in the budgets are based upon local conditions. Current prices and costs were used at the time the budgets were developed. These figures were then converted to adjusted normalized prices and costs in accordance with the instructions in paragraph 102.0212 of the Watershed Protection Handbook, using criteria found in "Interim Price Standards for Planning and Evaluating Water and Land Resources", which is an appendix of the "Economics Guide for Watershed Protection".

### Crop Yields

Data were gathered on crop yields for future conditions without the project and future conditions with the project. Crop yields were developed and reviewed by local SCS and Extension Service personnel, food processing plan fieldmen, the McKay Water Control District Board of Directors, and the Washington County Soil and Water Conservation District supervisors.

# ANALYSES

## FLOOD PREVENTION

### Peak Flow Studies

Precipitation values were estimated from U.S. Weather Bureau Technical Paper 40. Runoff curve numbers were developed for each sub-area from the land use data and soils map. Time of concentration for each subarea was calculated using ES-1015. Travel time and routing coefficients were developed using average bankful velocities. Reach lengths were measured from 7-1/2 minute quad sheets.

Soil Conservation Service Technical Release 20, "Project Formulation Program - Hydrology", was used to develop discharge frequency curves for various reaches for present and project conditions. The Technical Release 20 discharge values for both present and project conditions were adjusted based on a regional curve of csm versus drainage area. The regional curve of csm versus drainage area was developed by the method described in Chapter 2, Part 1, National Engineering Handbook (NEH), Section 4.

### Floodwater Retarding Storage

Volume-duration-probability (VDP) data, developed by the SCS Central Technical Unit, were used to determine the 1% chance of occurrence ten day inflow volumes for each site. The average release rate for each site was determined from downstream conditions and desired levels of flood protection. Technical Release 33 was used to determine various combinations of average release rates and retarding storage.

Studies were made for McKay Creek Reservoir to determine the most economical combination of storage and channel improvement for flood protection. Recreation usage and land rights considerations limited the total available floodwater retarding storage in the Rock Creek Reservoir. The floodwater retarding storage for McKay Creek Reservoir is 6,270 acre feet with a maximum release of 465 cfs. The floodwater retarding storage for Rock Creek Reservoir is 3,800 acre feet and the maximum release rate is 566 cfs.

### Area Flooded

The reaches used in evaluation studies are:

- I. McKay Creek Site to McKay Creek at Sunset Highway.
- II. McKay Creek at Sunset to the confluence with Dairy Creek. This reach is affected by backwater from the Tualatin River.
- III. Rock Creek Site to confluence with Beaverton Creek.
- IV. Rock Creek at Beaverton Creek to confluence with Tualatin River. This reach is affected by backwater from the Tualatin River.

A curve of area flooded versus percent chance of occurrence was developed for each evaluation reach. Reach lengths were measured from 7-1/2 minute quad sheets. Depth was related to present conditions discharge and area flooded using water surface profiles and surveyed valley cross sections for evaluation reaches I and III.

The 100 year flood plain was delineated using the "Combination Method" in the American Society of Agriculture Engineers' Paper No. 68-232, Reckendorf. A comparison analysis of the 100 year water surface profile and valley cross section floodplain was made for evaluation reaches I and III. This comparison indicated that the 100 year delineated floodplain plus one valley cross section per reach could be used to determine the average annual area flooded for evaluation reaches II and IV.

Project condition discharges were determined for reaches I, II, III, and IV. The resulting reduction in depth was then related to a reduction in area flooded.

The backwater effect of the Tualatin River was considered in the development of area flooded versus percent chance of occurrence for evaluation reaches II and IV.

### Benefits

Crop damages were developed for several sizes of floods. These values and the area flooded versus percent chance of occurrence and length of inundation curves were combined to make damage frequency curves for crop damages with and without the project.

Bridge damage reduction benefits are based upon elimination of stages and velocities that would cause damage to bridge superstructures, abutments, or approaches.

Benefits due to saving in future bridge costs were converted into average annual benefits by the procedure shown in pages 2 and 3 of

Technical Note, "Watershed UD-6", dated June 21, 1966.

Indirect damages and damage reduction benefits were computed as a percent of direct damages and benefits by the method shown on page 31, Chapter 3, of the Economics Guide for Watershed Protection and Flood Prevention - 1964.

## IRRIGATION

### Yield Analysis

A frequency analysis of annual yield was made from the eleven years of record available for McKay Creek near North Plains. The procedure used is described in "Methods of Flow Frequency Analysis", Bulletin 13, Subcommittee on Hydrology, Inter-Agency Committee on Water Resources. These eleven years were correlated with a corresponding thirty-five years of record for the Tualatin River at West Linn using standard regression techniques. This correlation generated a total of thirty-five years of record for McKay Creek near North Plains and produced a second frequency line. This second frequency line was identical to the initial frequency line of annual yield. The annual yield was transferred to other locations within the watershed on a basis of drainage area.

### Yield Distribution

The streamflow records were analyzed to determine the pattern of annual runoff. Where adequate records were available, the actual records were used.

### Irrigated Areas

Because of the soils distribution, cropping pattern, and crop rotation involved, the entire irrigated area will be treated as one unit.

The project irrigated area will have two sources of water supply; McKay Reservoir and Rock Creek Reservoir. Generally the area north of Sunset Highway and east of Cornelius Pass Road will be supplied from the Rock Creek Reservoir. The remainder of the irrigated area will be supplied from the McKay Creek Reservoir.

The area supplied by Rock Creek Reservoir will be limited to about 2,070 acres. Additional irrigation demand would result in draw-down requirements that are not compatible with the recreation use planned for this reservoir.

## Net Irrigation Requirements

Consumptive use values for crops listed in the Tualatin Valley Section of OSU Special Report 194 were used. Consumptive use values for other crops (except strawberries) were computed by the method outlined in SCS TR-21. Water needs for strawberries were based on an analysis of present irrigation practices in the Tualatin Valley.

Average annual rainfall values were reduced to 80 percent values by statistical analyses and were also reduced to "effective" rainfall values by the method outlined in SCS TR-21 to compute the net irrigation requirement.

A soil moisture depletion of 50 percent of the available moisture will be allowed on pasture, caneberries, squash, alfalfa, red clover, and corn. This depletion allowance will be divided equally between the beginning and end of the irrigation season. Pole beans, bush beans, and cucumbers will have a moisture depletion allowance of 25 percent of the available moisture. This allowance will all be applied at the beginning of the season. No end of season allowance will be used due to crop quality maintenance. Broccoli will have no beginning of season allowance due to the late planting date and no end of season allowance due to crop quality maintenance. The project net irrigation requirement weighted for soils and crop distribution is 11.87 inches.

## Peak Use Rate

The peak period consumptive use rate used in system design was computed by the method outlined in SCS TR-21 with modifications to provide additional flexibility in the distribution system.

## Efficiencies

It is expected that, on a project basis, an application efficiency of 65 percent can be maintained.

The area irrigated from the Rock Creek Reservoir will have no transportation losses so the overall project efficiency will be 65 percent. The area irrigated from the McKay Reservoir will have transportation and operation losses between the reservoir and the pumping plant near Jackson Creek. These losses are estimated at 8%, giving an overall efficiency of 60% for this area.

The Pumpkin Ridge area does not have the transportation and operation losses common to the rest of the McKay delivery area; however, the potential for good on-farm delivery is not as good here as in the rest of the area (smaller areas, steeper land, etc.) so the 60% overall efficiency will be used for this area.

### Recovery Factor

Some recovery of waste water might be possible, but because of the "checkerboard" type system, it will not be practical to recover any significant amount of waste water in any way that it can be put in the system for re-use. For this reason, no allowance was made for waste water recovery.

### Existing Water Rights

Existing water rights will be fully honored to the extent that natural streamflow is available. All natural streamflow required by prior rights for beneficial use below the reservoir will be passed through the reservoir from April 30 to October 1 each year.

### Benefit Analysis

Primary Benefits - The irrigation benefit analysis is based on providing water to fully irrigate 7,770 acres with a reliability of providing a full supply 80 percent of the years. Weighted average net return per acre, with and without the project was determined using the crop budgets, yields, and cropping patterns developed for this area. Costs of associated land treatment measures and additional operation and maintenance due to installation of these measures were deducted to obtain net project benefits.

Secondary Benefits - The methods and percentages used in calculating the secondary benefits were obtained from Chapter 11, "Economics Guide for Watershed Protection and Flood Prevention", SCS, March 1964. Secondary benefit estimates are based on the impact of project installation on the local economy. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation and were not included in the benefit analysis.

## MUNICIPAL AND INDUSTRIAL WATER

Based on analysis of the water quality tests from McKay Creek, the consultant for Wolf Creek Highway Water District has indicated that the water can be treated at a reasonable cost and is adequate for M&I use. These consultants have also reviewed the proposed operation schedule for the McKay Reservoir and have agreed that it meets the peak demand and monthly requirements they have set forth for the M&I water.

The results of water source studies prepared for Washington County by a private consulting firm show McKay Reservoir as one of the sources which need to be developed to provide an adequate supply of water for this area. The studies were reviewed to be certain that the reservoir location, size and service area are compatible with the proposed master plan.

## RECREATION

The recreation facility designs are based upon analyses of local and adjacent recreation population pressure, site adaptation potential and sponsor capability. Based upon comparison with the Multnomah County Blue Lake Park facility east of Portland and with existing State Park facilities the Rock Creek development is designed for an annual use load of 400,000 visitor days with a daily peak use load of 10,000 visitors. A comparison of the McKay Creek development with similar existing sites indicates a design requirement for an annual use load of 100,000 visitor days with a daily peak load of 2,500 visitors.

The analyses was oriented toward day use picnicking, boating, watersports, fishing, playground athletics, and nature studies. The 1960 northwest Portland metropolitan population exceeded 200,000 people and was projected to increase some thirty percent by the year 1975. At present there are no reservoir based recreation areas serving this population area. The comparison sites at Blue Lake Park and Ox Bow Park serving the east Portland population area are experiencing annual visitor usage in excess of 600,000 and 300,000 respectively and State Parks have usage of 400,000 to over 1,000,000 annually.

Without exception recent area planning reports specifically emphasize the need for water based recreational developments within the watershed area.

## STRUCTURAL MEASURES

### BASIS FOR STRUCTURAL DESIGN

#### Design Hydrographs

The structure classification of the reservoirs was established by the State Conservation Engineer using criteria in the Watershed Protection Handbook and Engineering Memorandum SCS-27 (Rev.), "Earth Dams".

The principal spillway hydrographs were developed using the VDP data and dimensionless mass curves from Chapter 21, Part 1, NEH-4. The procedure in Chapter 21, Part 1, NEH-4 for estimating the 10 day inflow volumes was used as a check.

Emergency spillway design and freeboard hydrographs were developed for the 6 and 24 hour B distribution storms and the 48 and 72 hour duration storms from the USWB Hydrometeorological Report #43. A study using the structure site analysis computer program indicated that the 24 hour B distribution storm was the critical design storm according to the criteria in Engineering Memorandum SCS-27 (Rev.). Design routings were started at the crest of the emergency spillway.

### Joint Use Studies

Analysis of streamflow and climatological records indicated that 100 percent joint use of the floodwater retarding storage with irrigation storage was possible for both the McKay Reservoir and the Rock Creek Reservoir. Operation schedules proposed by other agencies indicated that the allocation of the joint use storage could be done on a fixed time basis rather than on a forecast basis.

The proposed allocation schedule for the floodwater retarding storage in McKay Creek Reservoir is: 100% available through February 1, 66.4 percent available through March 1, 32.3 percent available through April 1 and 0 percent available after May 1. Analysis showed that, even with unusual storm timing, by using the proposed allocation schedules the flood prevention benefits can be realized. Reservoir operation studies, based on the generated thirty-five years of record, showed that the proposed schedules for allocation of floodwater retarding storage are feasible and the proposed demand schedule will be fully met eight out of ten years.

The proposed allocation schedule of the floodwater retarding storage in Rock Creek Reservoir is; 100 percent available through March 1, 50 percent available through April 1, and 0 percent available after May 1. Analysis showed that (even with unusual storm timing) by using the proposed allocation schedule, the flood prevention benefits can be obtained and the proposed water supply demand schedule will be fully met eight out of ten years.

### McKay Creek Reservoir

The preliminary plans for the McKay Creek Reservoir are based on a gravel fill structure with a compacted earth core and a grout curtain extending to a maximum depth of 100 feet below the bottom of the core trench in the abutment area (see Figures 3, 4 and 5, and Table 3). The grouting plan was developed following procedures covered in USACE Foundation Grouting Manual and the USBR Manual on Pressure Grouting. This dam was planned using criteria for a class "C" structure.

The embankment design is based on the results of the investigation of foundation conditions and on a maximum use of materials adjacent to the dam site and reflects the fact that the structure is located in an active seismic area. Zoning of the fill was determined by the testing of construction materials and a determination of the most economical zoning considered quality and amounts of fill materials available.

The borrow area lying between the maximum and minimum pools will be shaped after removal of embankment material to prevent formation of isolated pools in which fish could be stranded during reservoir drawdown.

The 100 year sediment storage requirement was determined by using an average sediment yield rate of 0.14 acre feet per square mile for the 23.5 mile drainage area above the site. The site trap efficiency is computed to be 96 percent using the capacity-inflow method. Total required sediment capacity will be 318 acre feet.

The discharge of the principal spillway will be limited to 465 cfs. This release rate reflects the most economical combination of channel improvement and floodwater storage to obtain the required flood protection.

The emergency spillway will be located on the left abutment and will have the capacity to discharge the routed design storm. Because of the poor structural conditions for a chute spillway, a drop inlet riser, closed conduit, and SAF basin, all of reinforced concrete, will be used for the emergency spillway.

The capacity of the drop inlet riser, conduit, and SAF basin was determined by routing the emergency spillway design storm hydrograph by the convex method as outlined in SCS-NEH-4. The dimensions of the drop inlet riser and conduit were determined by standard hydraulic computation methods. Model studies of this structure may be required during design. The dimensions of the SAF were determined by procedures outlined in SCS-NEH-Section 14.

The dimensions of the auxiliary spillway located on the right abutment were determined by calculating the most economical spillway width in relation to dam height. The capacity of the auxiliary spillway was determined by routing the freeboard storm hydrograph beginning at the crest of the emergency spillway. The routing was done by the convex method as outlined in SCS-NEH-4.

Wave free board was computed using Stephenson's Equation and was checked with criteria presented in the U.S. Bureau of Reclamation publication, "Design of Small Dams".

#### Rock Creek Reservoir

The preliminary plans for the Rock Creek Reservoir are based on a homogeneous earth fill structure with a vertical drain in the downstream section. The dam was planned using criteria for a class "C" structure.

The embankment design is based on foundation conditions, maximum use of readily available fill material, and reflects the fact that the structure is located in an active seismic area.

The borrow area lying between the maximum and minimum pools will be shaped after removal of embankment material to prevent formation of isolated pools in which fish could be stranded during reservoir draw-down.

The 100 year sediment storage requirement was determined by using an average sediment yield rate of 0.25 acre feet per square mile for the 19.2 mile drainage area above the site. The site trap efficiency is computed to be 95 percent using the capacity-inflow method. Total required sediment capacity will be 456 acre feet.

The discharge of the principal spillway will be limited to 566 cfs. This release rate reflects the most economical combination of channel improvement and floodwater storage to realize the required downstream flood protection.

The emergency spillway will be located near the left abutment and will have the capacity to discharge the routed design storm. A two-way covered riser, closed conduit, and SAF Basin, all of reinforced concrete, will be used for the emergency spillway. This type of spillway was chosen because it required the least amount of operating head and therefore the least fluctuation in the floodwater retarding pool.

The capacity of the two-way covered riser, conduit, and SAF Basin was determined by routing the emergency spillway design storm hydrograph by the "convex method" as outlined in SCS-NEH-4. The dimensions of the two-way covered riser and conduit were determined by procedures outlined in SCS TR-29.

The dimensions of the SAF were determined by procedures outlined in SCS-NEH Section 14.

The dimensions of the auxiliary spillway located on the left abutment were determined by calculating the most economical spillway width in relation to dam height. The capacity of the auxiliary spillway was determined by routing the freeboard storm hydrograph beginning at the crest of the emergency spillway. The routing was done by the convex method as outlined in SCS-NEH-4.

Wave freeboard was computed using Stephenson's Equation and was checked with criteria presented in the U.S. Bureau of Reclamation publication, "Design of Small Dams".

### Operation Studies

Operation studies were made for McKay and Rock Creek Reservoirs. For both reservoirs it was assumed that the recreation pool was at its minimum level and could be used as the starting elevation.

The average monthly evaporation rates were computed using SCS-NEH-4, Chapter 9, and U.S. Weather Bureau TP-37. The average monthly precipitation was determined using U.S. Weather Bureau data. The monthly precipitation values were subtracted from the evaporation rate figures to determine net monthly evaporation rates.

Reservoir seepage loss estimates were made by interpretation of bedrock permeability values determined during core drilling and analysis of permeability tests of undisturbed soils samples from the reservoirs.

Releases required for anadromous fish mitigation were arrived at by consultation with the Fish Commission of Oregon, Oregon State Game Commission, and the U.S. Fish and Wildlife Service.

The annual distribution of the municipal and industrial water supply is based on an analysis of the past annual use distribution of the systems now delivering water under similar conditions in the nearby areas.

The initial operation studies were made using a computer program. Several assumptions as to irrigated area, M&I demand, and minimum pool size were tried for each reservoir and checked against streamflow records to determine reliability. Analysis of the computer data led to the final assumption for the project. These assumptions were checked by an operation schedule similar to that set forth in SCS-TR-19.

### Irrigation Pipelines

Pipeline capacity is based on the project peak period use rate with continuous 24-hour per day irrigation during the peak period. The pipelines were designed to provide a delivery of water at a minimum pressure of 50 psi.

### C O S T   E S T I M A T E S   F O R S T R U C T U R A L   M E A S U R E S

Cost estimates for structural measures are based on the preliminary design for each measure and reflect current prices for similar work in this locality. Where local information was not available, costs for similar construction in other areas were used with appropriate adjustment for local conditions by analyses of production rates, cost for equipment, availability of material, accessibility, topography of the site, and size of the structure.

Data for cost estimates for road relocation was obtained from the Washington County Department of Public Works.

Data for cost estimates for the relocation of the Bonneville Power Line was obtained from the Bonneville Power Administration.

Contingencies up to 30 percent were added for each construction cost item depending on the complexity of the item and the possibility of unforeseen costs. The average contingency for all structural items is 20 percent.

## ALTERNATIVE RESERVOIR SITES STUDIED

### Upper Rock Creek Site

A dam and reservoir site in Section 7, T1N, R1W was investigated. Preliminary plans were prepared for a reservoir storing 9,000 acre feet and having a surface area of 430 acres. Foundation investigations of the dam indicated no significant foundation problems. The analysis indicated that high utility relocation costs for this site make it more expensive than the lower site and the larger water surface at the lower site would provide significantly more benefits.

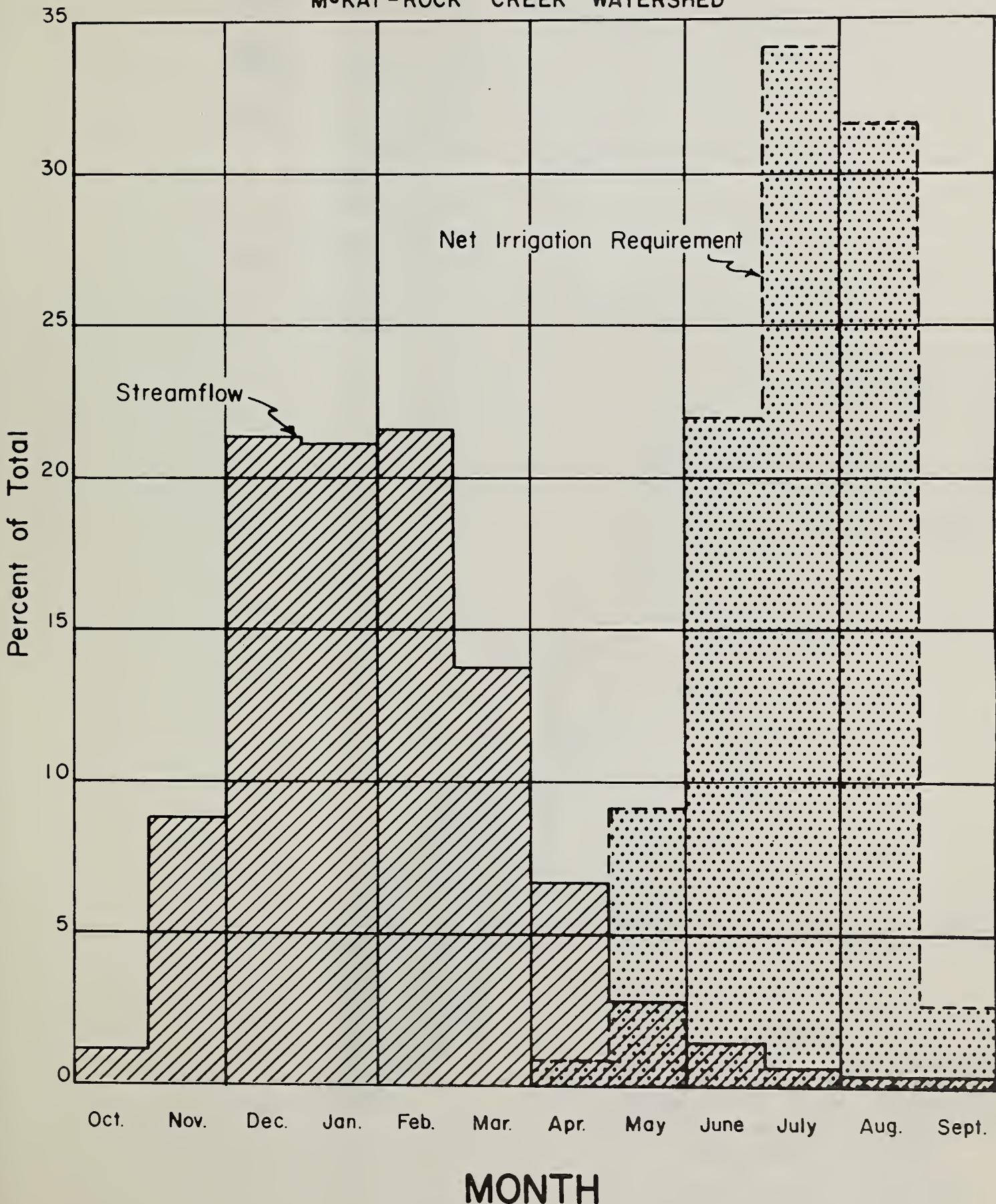
### Lower McKay Site

A dam and reservoir site was investigated by the U.S. Army Corps of Engineers on McKay Creek in Section 30, T2N, R2W. Additional work on this site was done during initial planning of this project to determine current construction costs, land rights, and watershed yield. Analysis of the investigational data indicated that the foundation conditions were more favorable at the upstream site selected, which also had the capacity to store the reliable yield of the McKay Creek Watershed. In addition, the lower site would destroy all existing anadromous fishery spawning habitat on this drainage. A dam at the upstream location would be above approximately 50 percent of these spawning areas.

Figure I

# ANNUAL DISTRIBUTION of STREAMFLOW AND NET IRRIGATION REQUIREMENT

MCKAY - ROCK CREEK WATERSHED





## LEGEND

- Upland hill and mountain soils.  
Typical series - GOBLE
- Rolling upland soils, imperfectly drained.  
Typical series - CASCADE
- Terrace soils, moderately well drained.  
Typical series - HELVETIA
- Terrace soils on the valley floor, well drained,  
medium to high water holding capacity.  
Typical series - WOODBURN
- Valley floor soils, imperfectly drained.  
Typical series - ALOHA
- Flood plain and flat terrace soils, poorly drained.  
Typical series - DAYTON

Isohyets

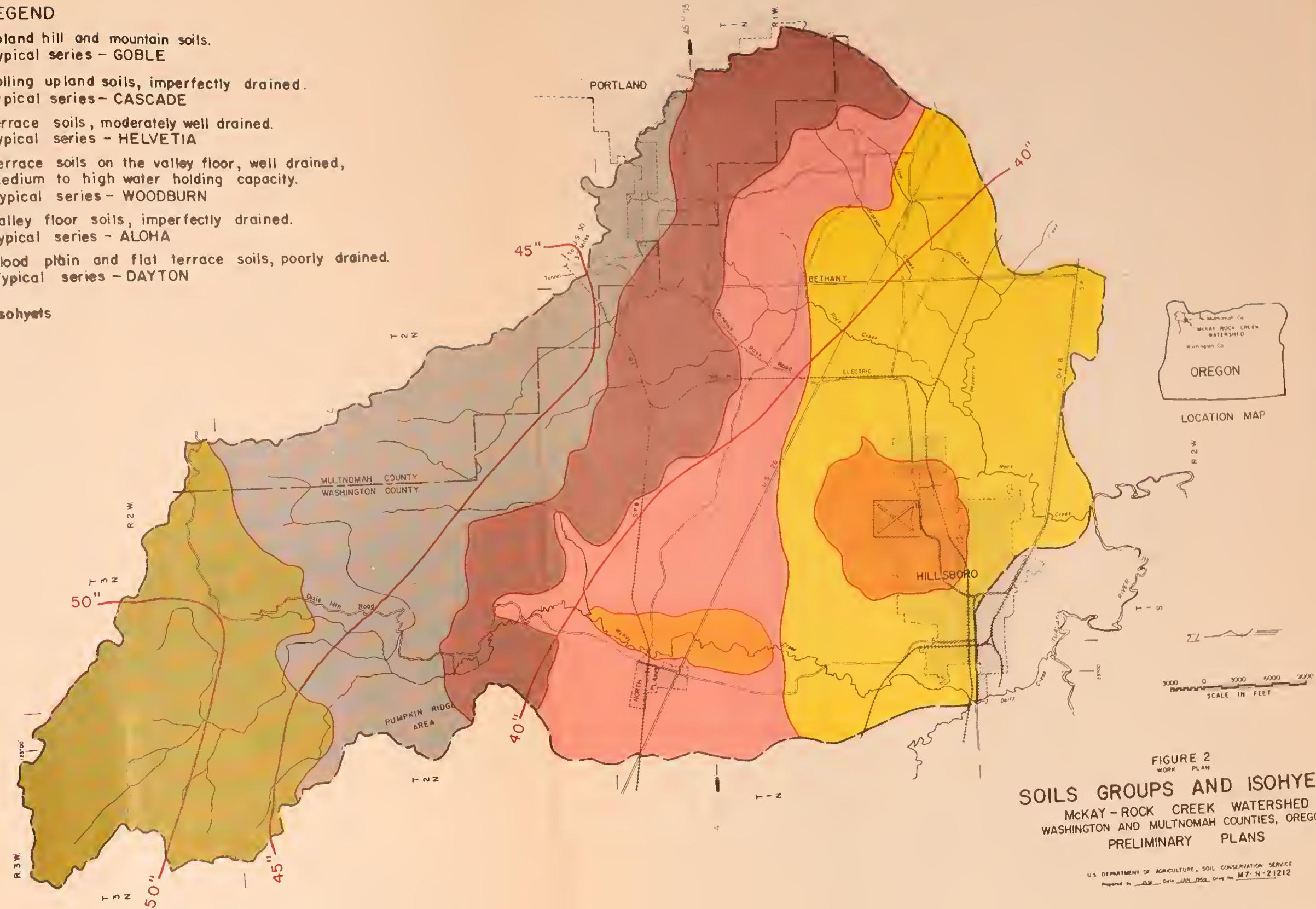
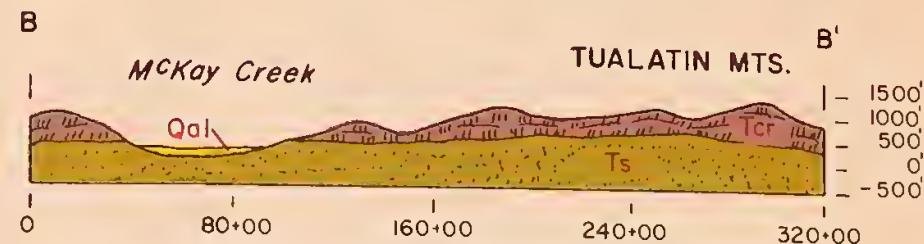
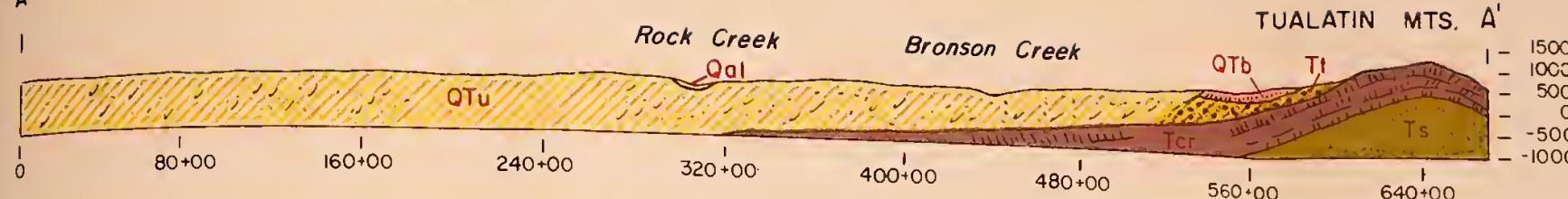


FIGURE 2  
WORK PLAN  
SOILS GROUPS AND ISOHYETS  
McKAY-ROCK CREEK WATERSHED  
WASHINGTON AND MULTNOMAH COUNTIES, OREGON  
PRELIMINARY PLANS

Prepared by JAM Date JAN 1961 Drawn No. M7-N-21212



### TUALATIN VALLEY



### LEGEND

**Qal** Younger alluvium. Clay, silt, sand, peaty materials, and some gravels. Ranging in thickness from 1 to 30 feet.

**QTu** Valley fill, undifferentiated. Clay, silt, fine sand, and a few gravel beds. Thickness ranges from 30 to over 1400 feet.

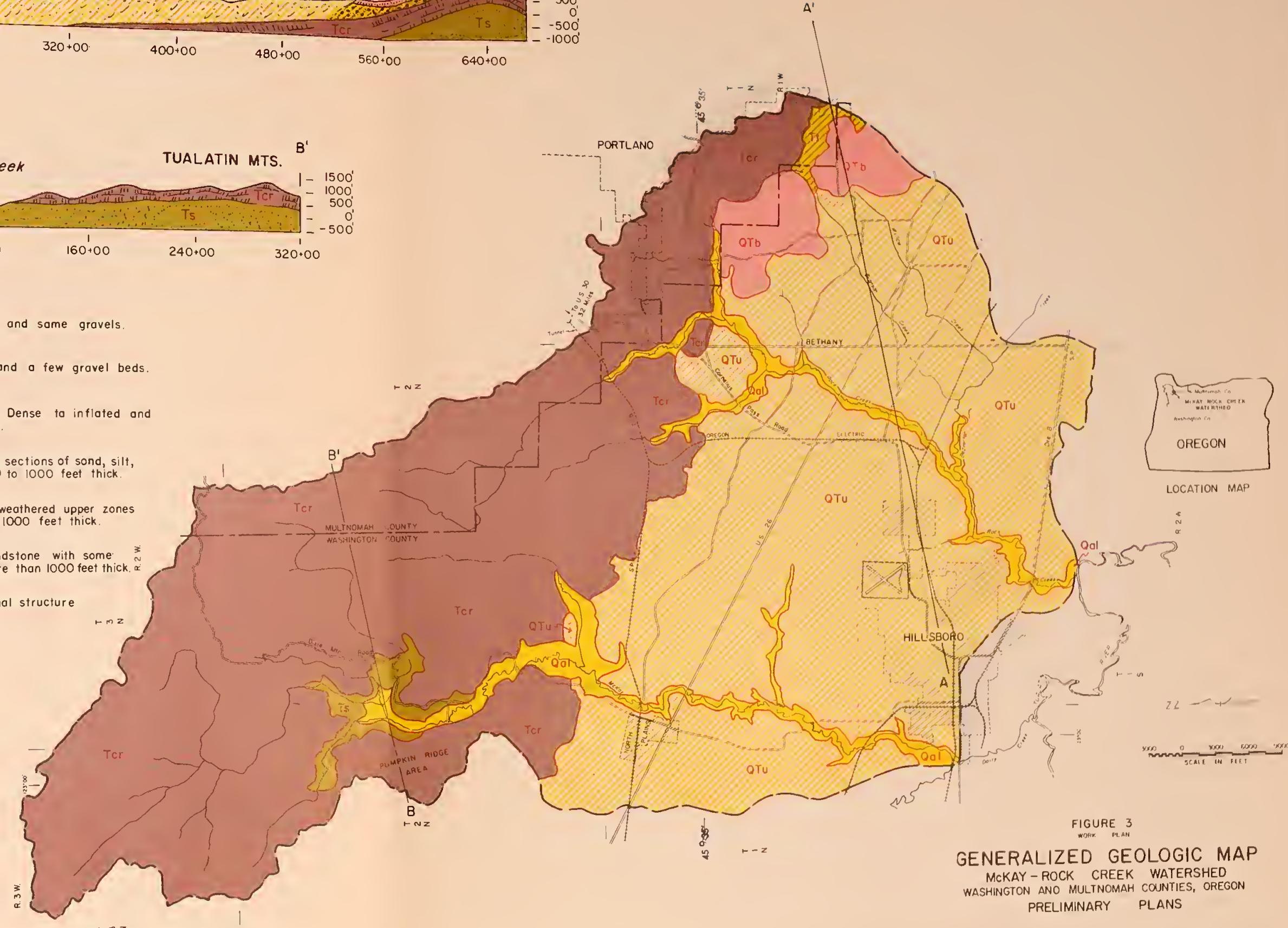
**QTb** Boring lava. Basaltic lava with minor breccia layers. Dense to inflated and massive to closely jointed. About 300 feet thick.

**Tcr** Trautdale gravels. Fine to coarse gravels with thin sections of sand, silt, and clay. Thickness of section approximately 500 to 1000 feet thick.

**Tcr** Columbia River Basalt. Basaltic lava with highly weathered upper zones. Massive to highly jointed flow on flow. About 500 to 1000 feet thick.

**Ts** Sedimentary rocks, undivided. Tuffaceous shale, sandstone with some gravels. Massive and well bedded marine deposits. More than 1000 feet thick.

**A-A'** Geologic structure sections generalized to show regional structure and stratigraphic relations.





**LEGEND**

- RECREATION POOL
- STORAGE POOL
- RECREATION DEVELOPMENT
- APPROXIMATE TAKE LINE
- OUTLET THROUGH DAM
- EXISTING ROADS
- ROAD RELOCATIONS
- FISH AND IRRIGATION PUMPING FACILITIES

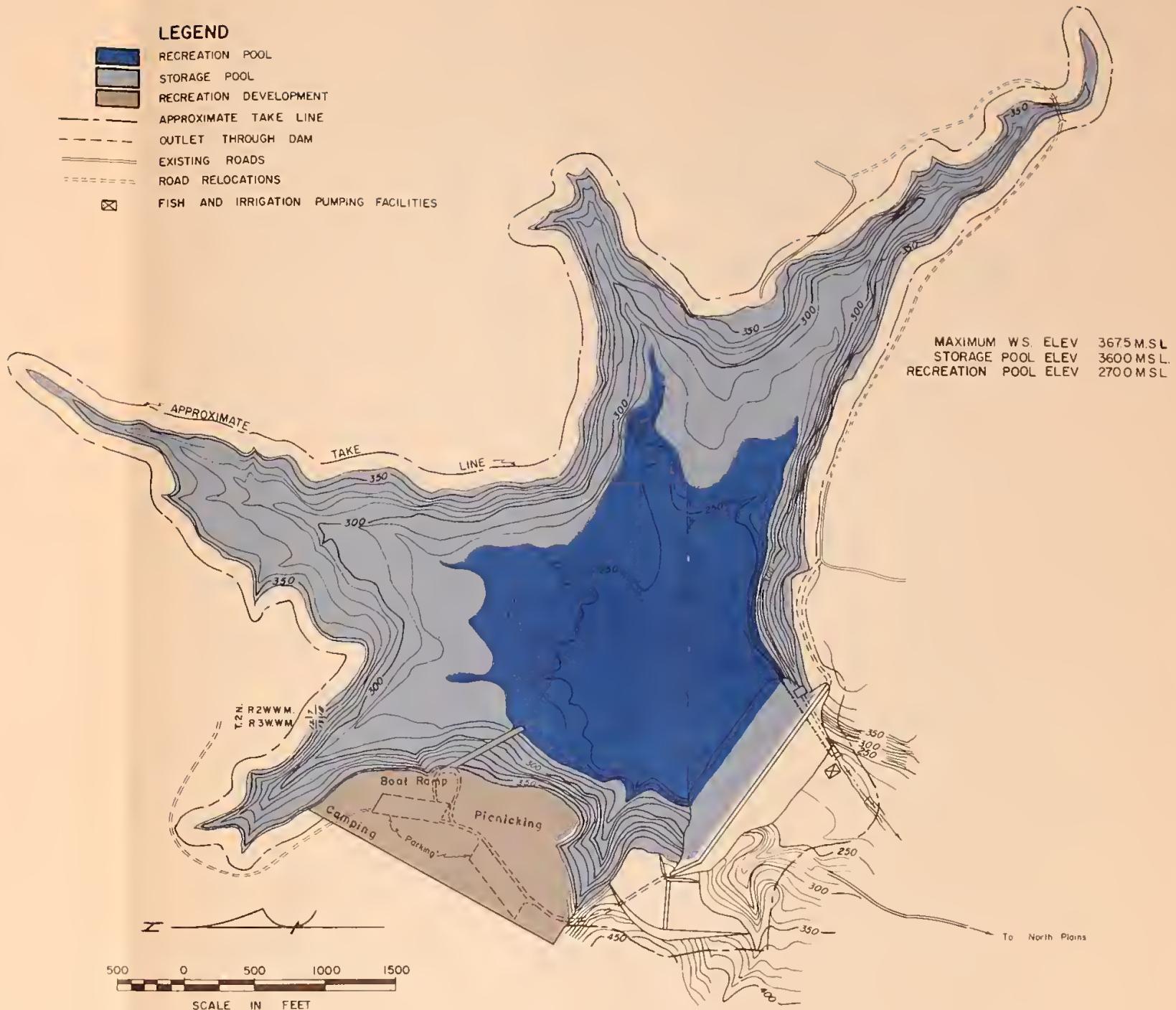


FIGURE 4  
WORK PLAN  
MCKAY CREEK RESERVOIR  
AND RECREATION DEVELOPMENT  
MCKAY-ROCK CREEK WATERSHED  
MULTNOMAH AND WASHINGTON COUNTIES, OREGON  
PRELIMINARY PLANS  
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Prepared by jsm Date Jan '69 Drug No M7-N-21213



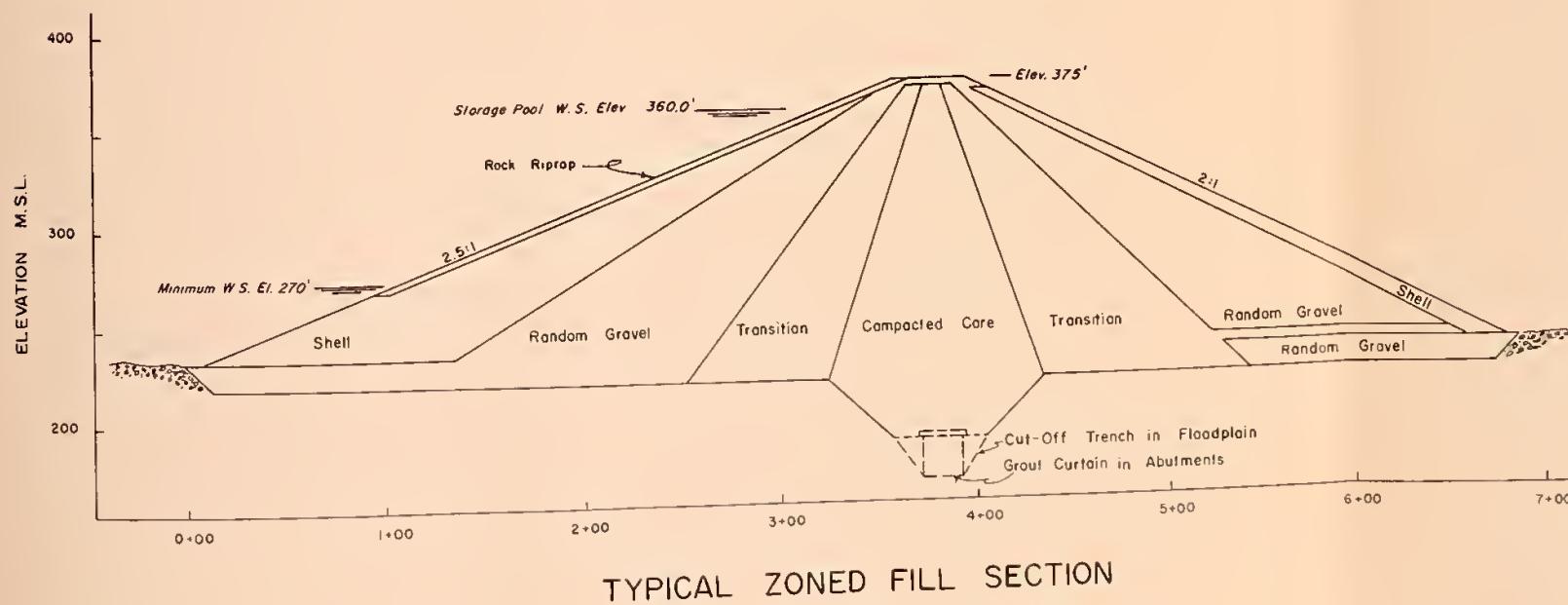
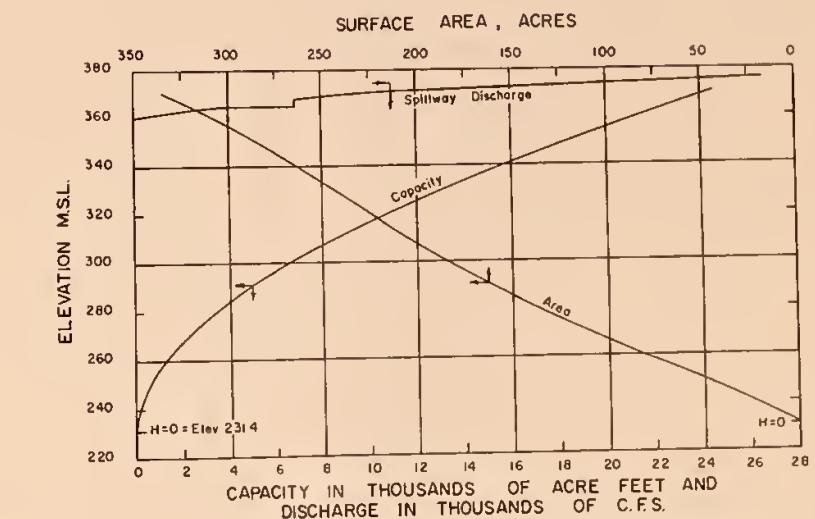
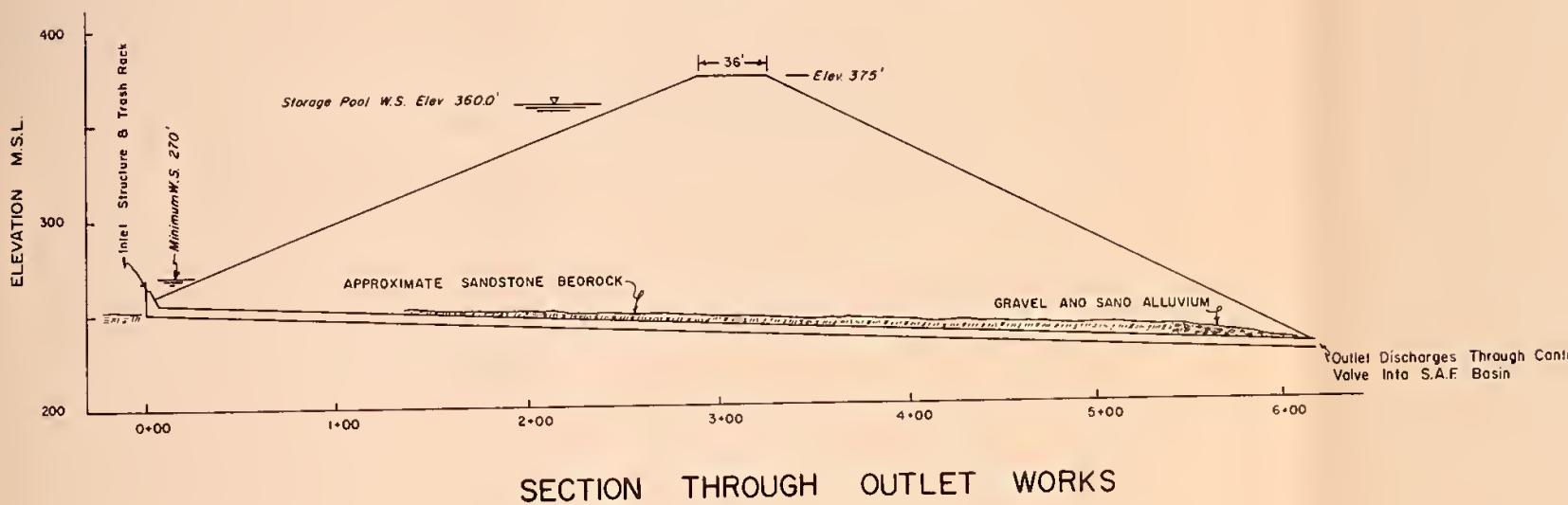
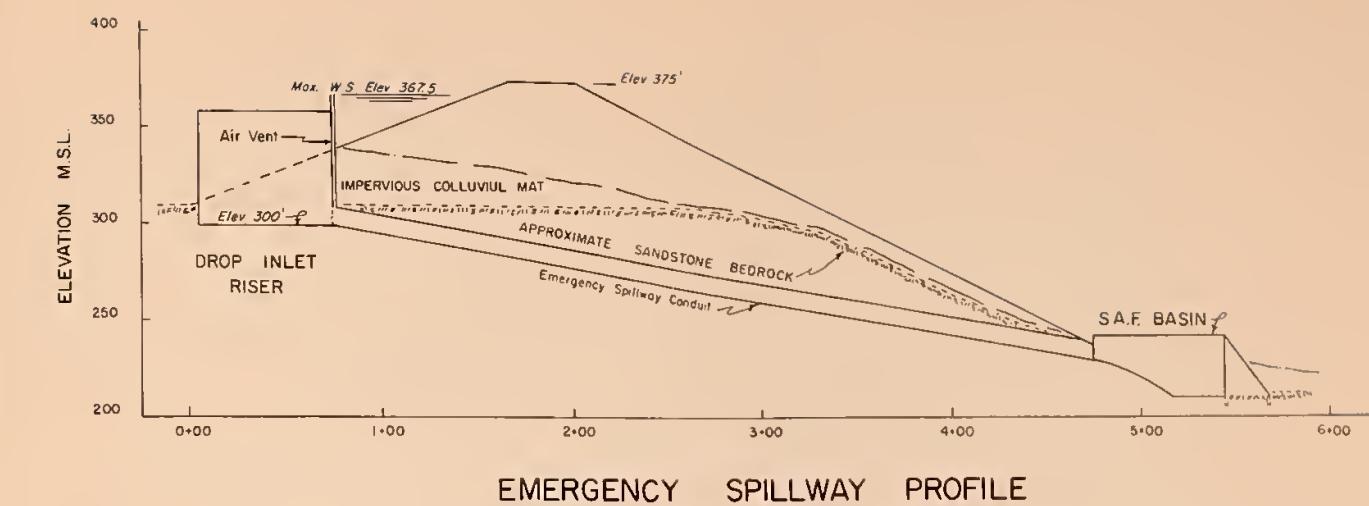
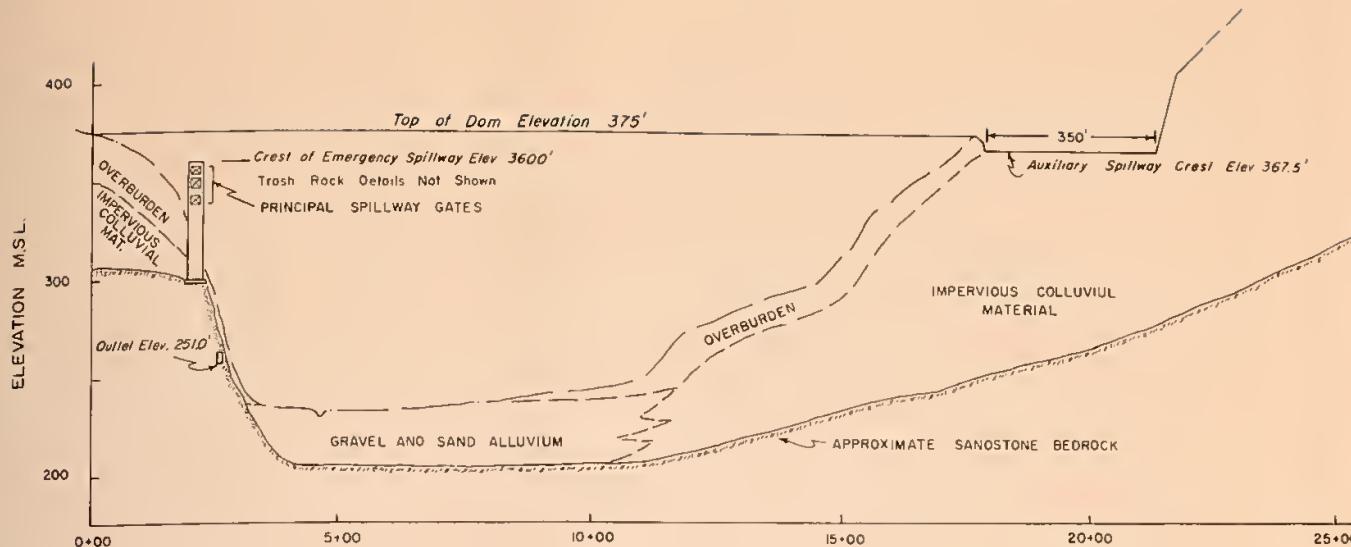
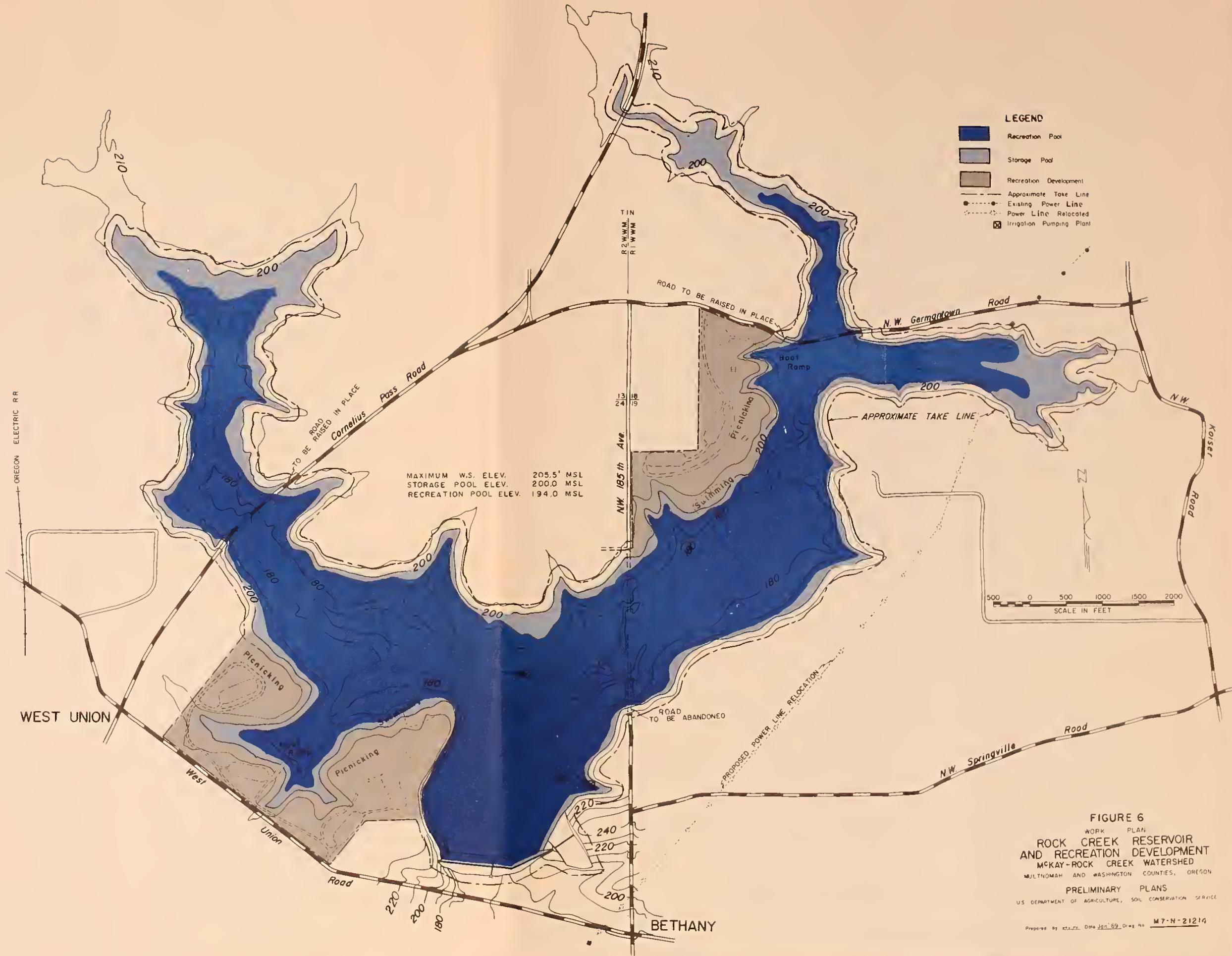


FIGURE 5  
WORK PLAN  
**MCKAY CREEK DAM**  
MCKAY-ROCK CREEK WATERSHED  
WASHINGTON & MULTNOMAH COUNTIES, OREGON  
PRELIMINARY PLANS  
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Prepared by MRV, ISM Date 9-1-68 Drawing No 7-E-18386





**FIGURE 6**  
 WORK PLAN  
 ROCK CREEK RESERVOIR  
 AND RECREATION DEVELOPMENT  
 MCKAY-ROCK CREEK WATERSHED  
 MULTNOMAH AND WASHINGTON COUNTIES, OREGON  
 PRELIMINARY PLANS



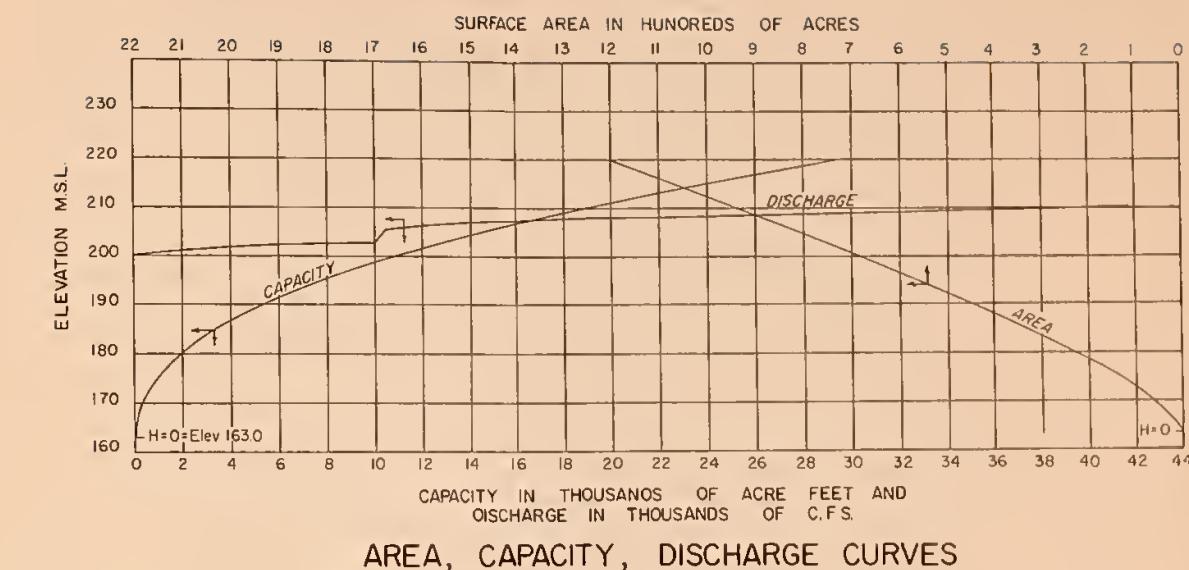
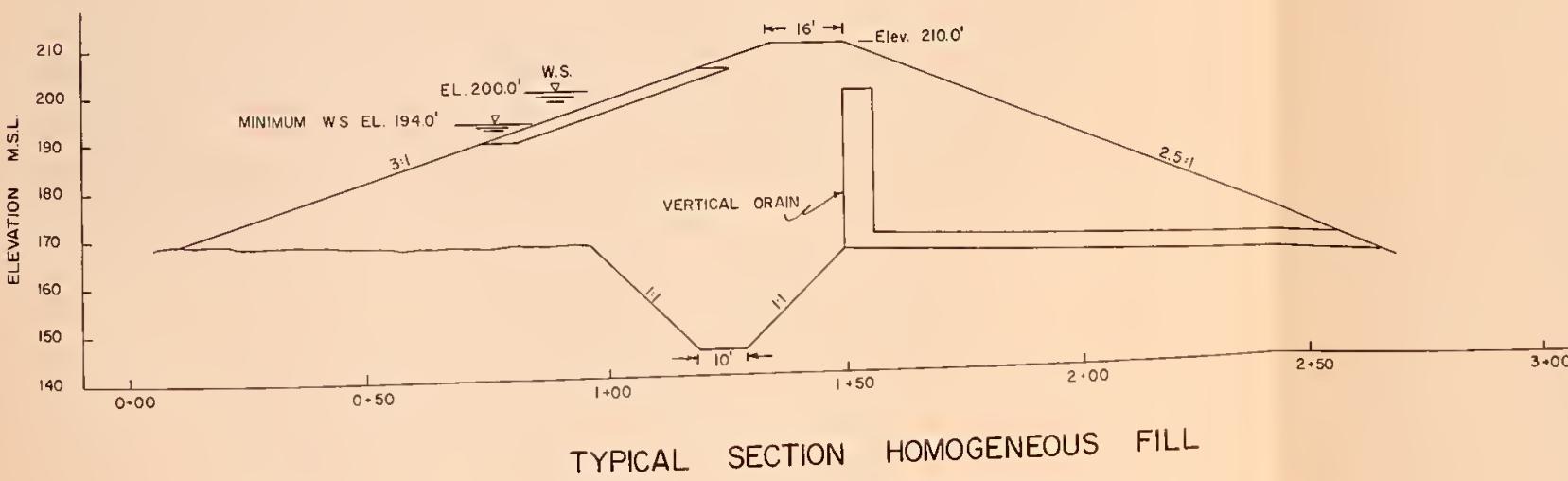
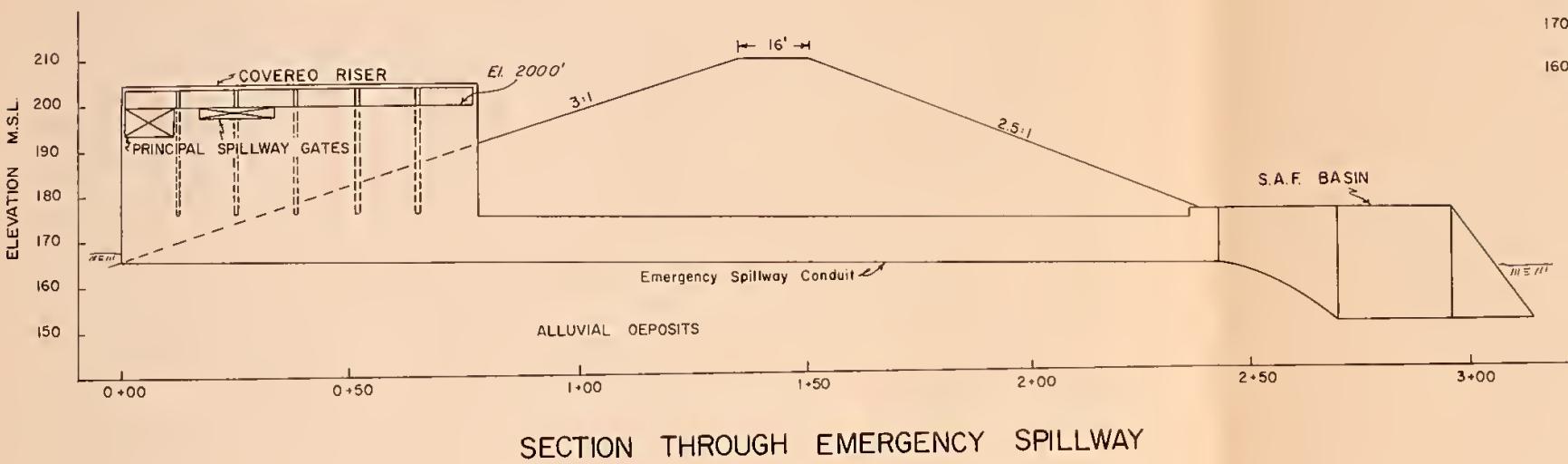
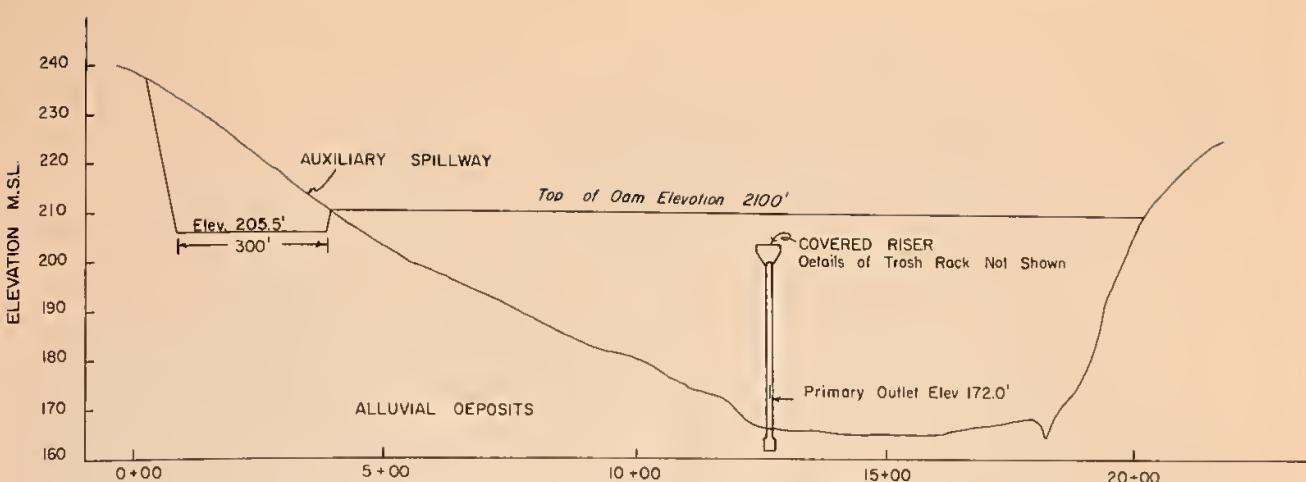


FIGURE 7  
WORK PLAN  
ROCK CREEK DAM  
MCKAY-ROCK CREEK WATERSHED  
WASHINGTON & MULTNOMAH COUNTIES, OREGON  
PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE



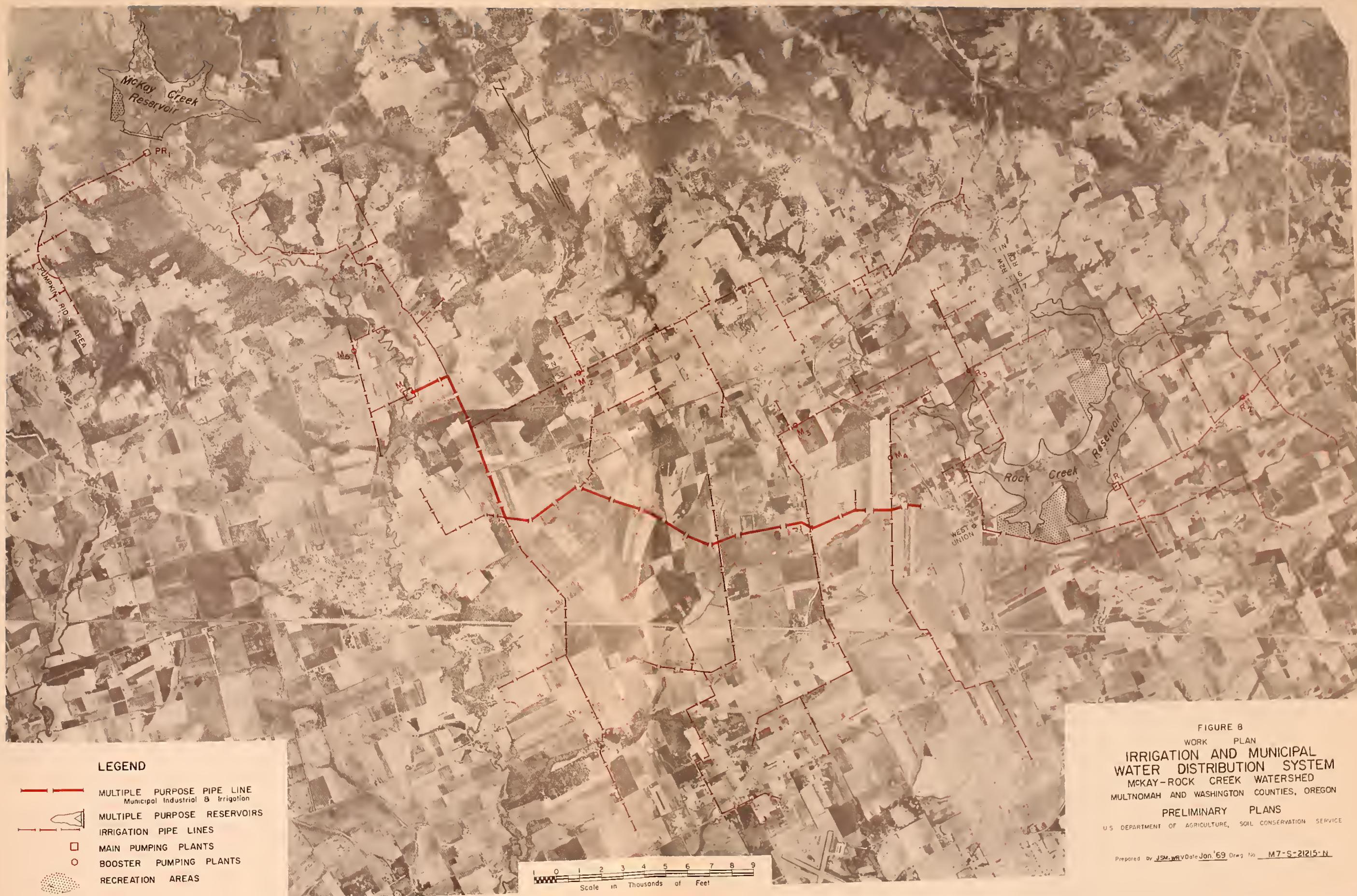
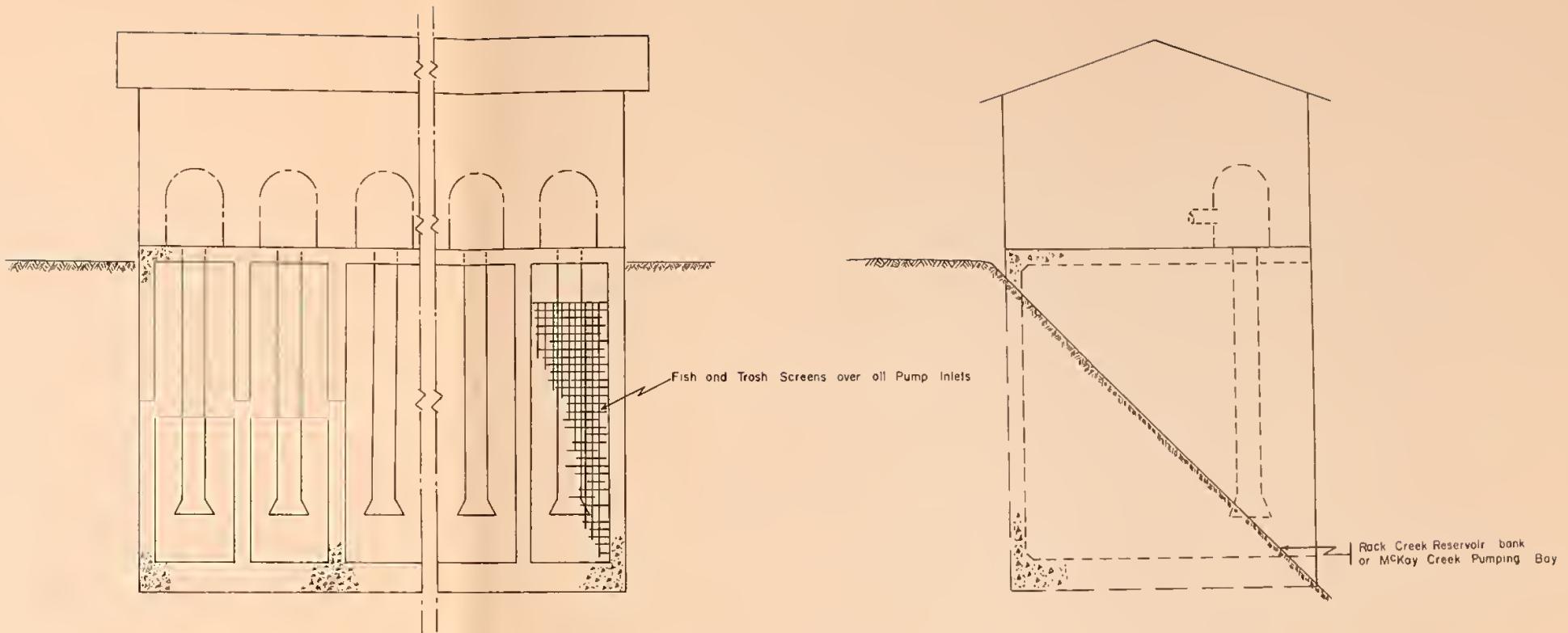


FIGURE 8  
WORK PLAN  
IRRIGATION AND MUNICIPAL  
WATER DISTRIBUTION SYSTEM  
MCKAY-ROCK CREEK WATERSHED  
MULTNOMAH AND WASHINGTON COUNTIES, OREGON  
PRELIMINARY PLANS  
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

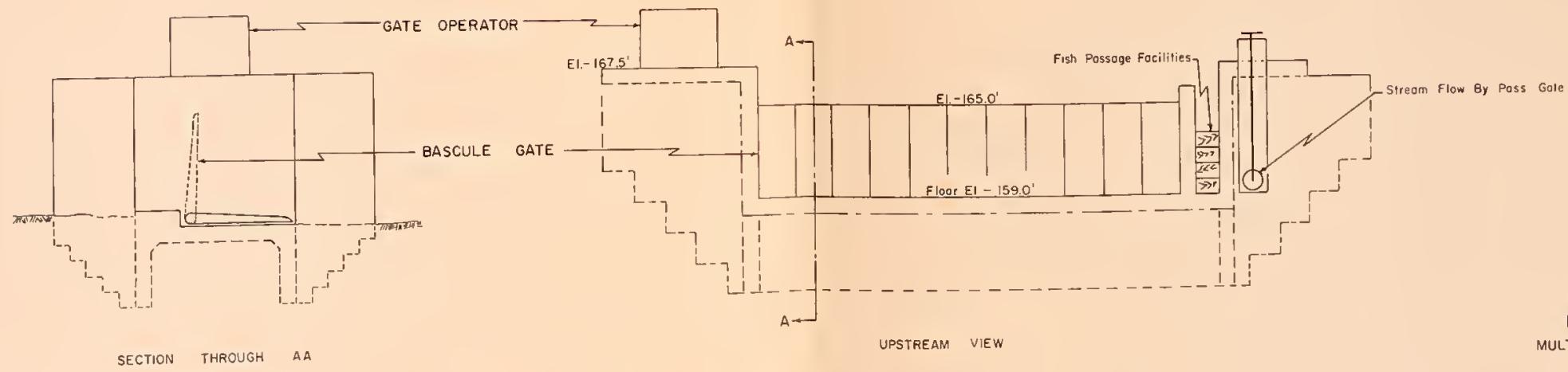
Prepared by JSM-WRV Date Jan '69 Draw No M7-S-21215-N





TYPICAL PUMPING PLANT  
MCKAY CREEK OR ROCK CREEK FACILITY

HORIZONTAL AND VERTICAL SCALE  
5 0 5 10  
Scale in Feet



MCKAY CREEK CHECK DAM

FIGURE 9  
WORK PLAN  
PUMPING PLANT AND  
CHECK DAM DETAIL  
MCKAY-ROCK CREEK WATERSHED  
MULTNOMAH AND WASHINGTON COUNTIES, OREGON  
PRELIMINARY PLANS

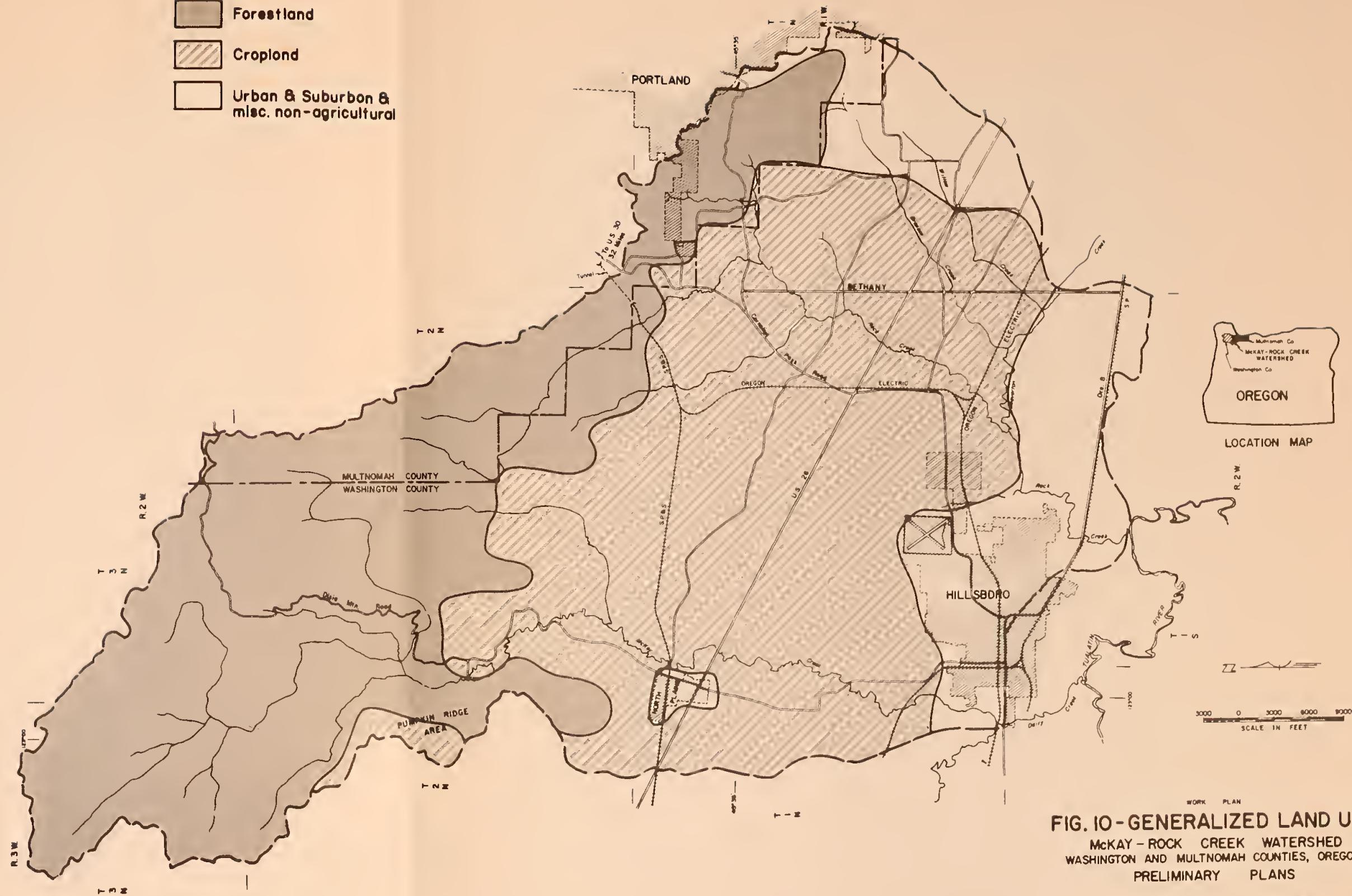
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Prepared by W.W. Johnson Date Jan 1969 Draw No. 7-E-18386



LEGEND

- Forestland
- Cropland
- Urban & Suburban & misc. non-agricultural



WORK PLAN  
**FIG. 10 - GENERALIZED LAND USE**  
 MCKAY - ROCK CREEK WATERSHED  
 WASHINGTON AND MULTNOMAH COUNTIES, OREGON  
 PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE  
 Prepared by KC-MT Date 04-09-69 Drawn M7-H-B134R



## LEGEND

Multiple Purpose Structure  
 F - Flood Prevention  
 I - Irrigation  
 R - Recreation  
 M - Municipal Industrial

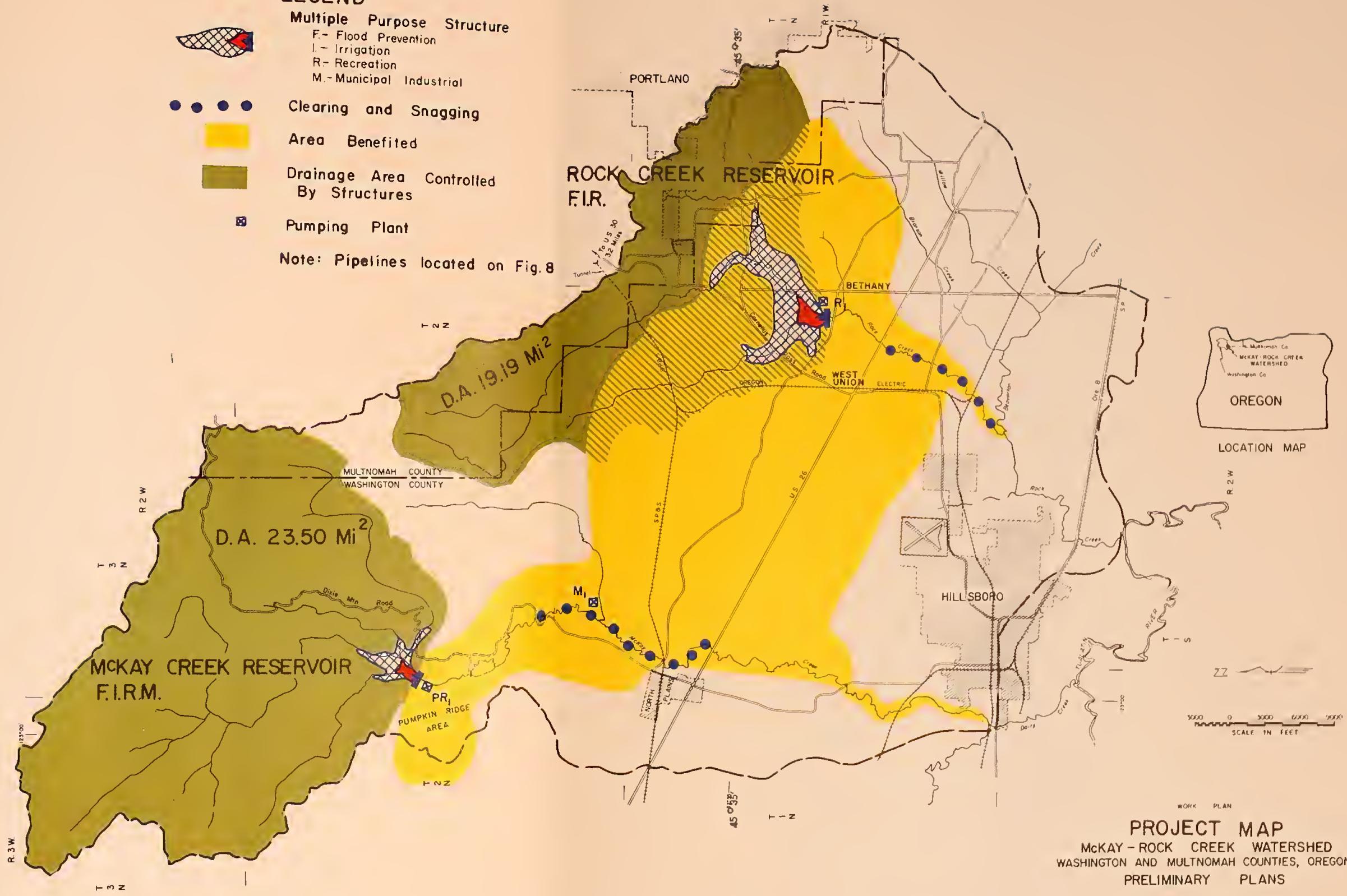
• • • • Clearing and Snagging

Area Benefited

Drainage Area Controlled By Structures

■ Pumping Plant

Note: Pipelines located on Fig. 8



PROJECT MAP  
 MCKAY - ROCK CREEK WATERSHED  
 WASHINGTON AND MULTNOMAH COUNTIES, OREGON  
 PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE  
 Prepared by SAC Date JAN 1952 Drawing No. M7-H-2121Q

